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QUARTERLY

OF THE

National Fire Protection Association

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National Fire Protection Association

INTERNATIONAL

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Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

Portsmouth, N. H., permits the unrestricted use of wooden shingle roofs, except in a small area in the business center. When a six-story furniture store burned on May 5, 1931, burning brands were carried long distances to ignite some twenty wooden shingle roofs. The largest damage from such fires occurred on the waterfront, half a mile from the original fire. Only the vigilance of householders in extinguishing incipient roof fires, and timely aid from out-of-town fire departments, prevented a sweeping conflagration.

The Quarterly

Vol. 25 July, 1931 No. 1

Pittsburgh's Fire Crackers. After recording certain loss of life and two or three hundred casualties as the result of the sale of fireworks in Pittsburgh last Independence Day, an effort was made in that city in May to secure legislation to protect Pittsburgh children from the ravages of this senseless pest this year. A bill of the modern sort was presented to Council advocating the use of pyrotechnics by professionals only in supervised displays. Public displays would not under this ordinance be interfered with; only the children would be protected. The peddlers of fire and child-death learned of the welfare proposition before the city, and found themselves sufficiently influential to secure the creation of a substitute ordinance and a majority in Council to enact it. The fire prevention committee of the Chamber of Commerce, all the Pittsburgh newspapers, and the women's organizations favored the original bill and were outraged by the political trick through which they were handed a worthless substitute for a safety measure. "Harmless" fireworks are those employing fire neither in their ignition nor operation. It is obvious there is none such. Where young children are concerned the use of the term is an affront to intelligence. The Pittsburgh women declared that the city government owed it to them to help preserve their children from gratuitous injury, blindness and death. After safeguarding their babyhood from fire with utmost vigilance, the practice of throwing them when a little older into a week of fire orgies, was a proceeding unworthy of human beings.

Women could not safeguard their own children so long as neighbor parents permitted playing with fire; one child could not be protected until all children were protected. The willingness of a commercial interest to jeopardize child life for money profit was something to bring censure from every upright man and woman.

The Council holding a public hearing as a "Safety" committee was not moved by such arguments. The spurious bill was passed by a vote of six to two.

In Pittsburgh, bills passed by the Council can be vetoed by the mayor, and the organizations originally moving for the safety measure transferred

their appeal from the Councilmen to the city executive. They failed. The Mayor approved the bill with the weasel words of the politician. Comfort may, however, be derived from the thought that this matter is not permanently closed. The Pittsburgh editors have instructed their reporters to look out for fireworks casualties, and it may be the aftermath of this action of the politicians will not be such as to entrench them any more securely in public esteem.

* * * * *

The Ubiquitous Smoker. The professional scoffers on the subject of the spontaneous ignition of agricultural products, particularly hay, are claiming support for their skepticism in the rather frequent ignition of hay and straw stacks not in barns but in barnyards and open fields. These stacks (and wooden shingle roofs) are exhibiting the faculty of taking fire soon after the passage of airplanes, and the assumed connection between the two is being increasingly reported from different parts of the country. Knowing the careless habits of passengers and drivers of automobiles in the disposal of stubs of cigarettes, it does not seem unreasonable to expect cigarette fires to be set by our flying population. A rather striking confirmation of this expectation is found in a recent despatch to the New York *Herald-Tribune* from Aberdeen, Maryland. Seventeen passengers on an Eastern Air Transport plane were reported as seriously endangered by a careless smoker. Skillful manipulation by the pilot landed the plane in a small field after it caught fire and no casualties resulted. It was shown that there was no fire in or about the engine. It had started in an upholstered couch and had made considerable headway when discovered by the hostess of the plane. She reported the matter to the pilot. Together they reassured the passengers and prevailed upon them to keep their seats and control their nerves while the pilot sought a landing area. The descent to the open field was safely managed. It is futile perhaps to waste breath in excoriation of the idiots of the air while they are running about in such numbers on the earth's surface.

* * * * *

Pier Fires Continue. The conflagrations in Norfolk and St. John, N. B., reported in this issue of the QUARTERLY, continue the bad fire record of waterfront property. In the last issue of the QUARTERLY the Providence, R. I., pier fire was reported, and in reviewing large loss fires of previous years recorded in the QUARTERLY a large proportion of the major loss fires appear to have been in pier and wharf property.

This class of property presents a peculiar fire hazard, owing to the difficulty of access for fire fighting and the prevalence of combustible sub-structures, large areas and construction and protection that fall far below the usual standards set for other classes of property. It is difficult to understand how the bad fire experience of pier and wharf property has continued for so many

years without having more influence on the character of construction and protection of such properties. The situation may perhaps be explained by a tendency on the part of pier owners to base their expenditures for fire safety merely on the savings in insurance premiums on the pier and wharf structure. The cargoes handled on piers, and the vessels berthed alongside, frequently involving values much greater than that of the pier itself, are largely under different ownership, with insurance so arranged that the pier owner has little direct financial incentive to so construct and protect his structure that the fire hazard to vessels and cargoes will be minimized.

The N.F.P.A. Committee on Piers and Wharves has been studying the problems of pier and wharf construction and protection for a number of years, and with the 1931 revision of the regulations on this subject, adopted at the recent Toronto meeting, has evolved recommendations that are accepted as thoroughly practical by port authorities. Shippers and ship operators are increasingly realizing the fire hazard of inferior pier facilities, municipal authorities are witnessing illustrations of how pier fires may develop into waterfront conflagrations, and it is to be hoped that the N.F.P.A. recommendations may in the future be definitely reflected in improved construction and protection of piers and wharves.

* * * * *

Windowless Buildings. Two factory buildings without windows, one in Fitchburg, Mass., and the other at Grand Rapids, Mich., are now under construction. Advocates of the building without windows anticipate an increased efficiency of operation owing to improved conditions through the substitution of artificial light and ventilation for the ordinary lighting and ventilation from windows. Heating problems will be greatly simplified in buildings without windows, the usual heat loss around windows being eliminated.

What effect upon fire hazards and fire protection will come with this new type of building construction remains to be seen. The first thought is the difficulty of access by firemen for fire fighting operations or life saving. Fire experience in basements without windows and in some other existing windowless occupancies, such as cold storage buildings, indicates that fire fighting operations may be much more difficult in buildings without window openings. It is obviously essential in such structures that special attention be given to the elimination of fire hazards and that ample interior fire protection be provided. Without windows more doors and stairways are apparently necessary to assure life safety.

Possibly some special technique of fire fighting may be developed for the windowless building. With air-tight walls and floors, fires may perhaps be extinguished by sealing off the space where fire occurs, thus extinguishing the fire by depriving it of air. In any case this is a development which will be watched with much interest by fire protection engineers.

Meeting of Board of Directors.

Toronto, May 11, 1931.

Members Present.

Albert T. Bell, Atlantic City, Chairman

Frederick T. Moses, Providence, President
Sumner Rhoades, New York, Vice-President
Harold L. Miner, Wilmington, Vice-President
Dana Pierce, Chicago, Past President
Franklin H. Wentworth, Boston, Managing Director
Eugene Arms, Chicago
Eugene Chrystal, Rochester
Geo. W. Elliott, Philadelphia
W. F. Hickey, New Haven
George F. Lewis, Toronto
S. D. McComb, New York
S. L. Nicholson, New York
C. W. Pierce, New York
D. J. Price, Washington
Benjamin Richards, Chicago
Richard E. Vernor, Chicago

Business Transacted.

The report of the Chairman to the annual meeting was read and approved.

The report of the Treasurer was approved.

A proposal to present the name of Rudolph P. Miller to the Association for election to honorary membership was approved.

Communication from manufacturer of electric wiring material concerning the result of the Electrical Committee's consideration of the principle of the proposed method of installation involved in the use thereof was discussed, and it was voted to instruct the Secretary to advise the manufacturer that the Directors consider the handling of the matter by the Electrical Committee regular and competent and see no reason to interfere with the orderly committee procedure.

A communication from a member concerning employment was referred to the Managing Director.

It was voted to hold the midsummer meeting of the Board in Providence, R. I.

Meeting of Board of Directors.

Providence, June 29, 1931.

Members Present.

Albert T. Bell, Atlantic City, Chairman
Frederick T. Moses, Providence, President
Harold L. Miner, Wilmington, Vice-President
Franklin H. Wentworth, Boston, Managing Director

Eugene Arms, Chicago	Charles W. Mowry, Boston
William H. Blood, Boston	S. L. Nicholson, New York
Frank R. Bradford, Boston	C. W. Pierce, New York
Eugene Chrystal, Rochester, N. Y.	D. J. Price, Washington, D. C.
George W. Elliott, Philadelphia	Benjamin Richards, Chicago
Samuel D. McComb, New York	Richard E. Vernor, Chicago

Mr. A. R. Small, Chairman of the Electrical Committee, was present by invitation.

Business Transacted.

Following recommendation of annual meeting, the following officers were elected for the fiscal year: President, Frederick T. Moses, Providence; Vice-President, Sumner Rhoades, New York; Vice-President, Harold L. Miner, Wilmington; Chairman of the Board of Directors, Albert T. Bell, Atlantic City; Managing Director, Franklin H. Wentworth.

Percy Bugbee was appointed Assistant Managing Director.

It was voted to hold the 36th annual meeting at Atlantic City during the week of May 9, 1932. It was voted inadvisable to recommend the place at this time for the 1933 annual meeting.

The usual program committee, consisting of the President, Managing Director and Chairman of the Board of Directors, was appointed. The program of the annual meeting was discussed, with helpful suggestions to the program committee.

The budget submitted by the Treasurer was approved.

Samuel D. McComb and S. L. Nicholson, both of New York, were selected to complete the Nominating Committee for 1932.

Technical Committee Affairs.

Committee on Electric Railway Car Houses and Cars.

The following changes in the Regulations on Electric Railway Car Houses and cars (refer to edition of 1930 printed by Underwriters' Laboratories) were recommended by unanimous vote of this committee:

Insert "electrical metallic tubing" following the word "conduit" in the following places: Rules 1, 6(a) (3), 9(a), 10(b), 13.

Insert "or electrical metallic tubing" following the word "conduit" in Rule 6(c).

Insert a new item 6(a) (4) reading: "Approved electrical metallic tubing."

The above recommendations were adopted with the understanding that this action is not to be considered a precedent for the use of this material in

voltages exceeding those designated by the National Electrical Code for installations covered by the Code.

Committee on Hazardous Chemicals and Explosives.

In accordance with authorization of the Association in annual meeting, the committee submitted a list of amendments to the Regulations on the Storage and Handling of Nitrocellulose Motion Picture Film as presented in the 1931 report of the committee. These items were adopted and are officially recorded in the Executive Office and will appear in future printed editions of the regulations, being meanwhile accessible to interested members on request.

Committee on Field Practice.

In accordance with authorization of the Association in annual meeting, this committee recommended certain amendments to the Regulations governing First Aid Fire Appliances. These items were adopted and will appear in future printed editions of these regulations. They are meanwhile a matter of official record in the Executive Office and accessible to members on application.

Committee on Signaling Systems.

Following authorization by the Association in annual meeting, the Committee on Signaling Systems presented an edited edition of the Regulations for the Installation, Maintenance and Use of Central Station Protective Signaling Systems and for Proprietary Auxiliary and Local Protective Signaling Systems, the above to be published by the National Board of Fire Underwriters in separate pamphlets. The changes recommended by the committee were authorized by the Directors and will be embodied in the early forthcoming edition of these regulations.

Committee on Tanks.

In accordance with authorization of the Association in annual meeting, the Committee on Tanks presented for adoption certain revisions of the 1931 report governing tanks, gravity and pressure, towers, etc. These amendments were approved and will appear in the next published edition of these regulations and are meanwhile of official record in the Executive Office and available to members interested.

Electrical Committee.

Following authorization by the Association in annual meeting, the report of the Electrical Committee as amended was presented by Chairman A. R. Small with the text for the new edition of the National Electrical Code. The Code as presented was adopted and recommended to the National Board of Fire Underwriters for publication. This approval of the Code included the amendment permitting indoor location of meters ahead of service entrance equipment as approved by the Electrical Committee by special letter ballot. See sub-paragraph 3, Section 405(i).

Aviation Committee.

An informal report was submitted by Chairman Samuel D. McComb and referred to the Executive Office.

A communication on the subject of Section 508, National Electrical Code, was considered and referred to the Electrical Committee. It was voted that the Directors should not change the form of wording selected by the Electrical Committee for this section.

It was voted to request the Committee on Salvaging Operations to proceed with the production of rules for good practice for the information of fire departments carrying on salvage operations.

A communication concerning the reduction of the personnel of the Association's technical committees was laid upon the table.

The list of changes in technical N.F.P.A. committees submitted by the Managing Director was approved and authorization given for other changes now the subject of Executive Office correspondence. All such additions or revisions will appear in the rosters of committees printed in the forthcoming Year Book (1931).

An enthusiastic vote of appreciation was given to President Frederick T. Moses for facilities provided for the meeting and for his generous hospitality.

The 1930 Fire Loss.

Fire losses for 1930 are estimated by the National Board of Fire Underwriters at $499,739,132. This figure, determined since the publication of the April QUARTERLY, is approximately 8% greater than the preliminary estimate which appeared in that issue (see QUARTERLY, April, 1931, page 380). This loss figure is based upon returns made by the insurance companies reporting to the Actuarial Bureau, adding twenty-five per cent for uninsured and unreported losses.

The 1930 fire loss is approximately $40,000,000 greater than the total loss for 1929, an increase of about 8.8%. The per capita loss increased from $3.81 in 1929 to $4.07, an increase of 6.8%. In spite of this increase it is gratifying to note that the fire loss curve is still considerably below the high figures of the period from 1922 to 1926 inclusive. The 1930 figures for cities have increased in somewhat lower ratio than the national loss, showing an increase of 4.1% in total losses and 10.6% in per capita losses. The difference in per capita increase for cities is due to population adjustments on account of the 1930 census.

The following tables indicate the annual fire loss in the United States for fifty-six years and a comparison of losses on a per capita basis for the past ten years. In addition, there have been included tables showing the per capita losses of all cities of 100,000 population or over for a three-year period, and a table listing all cities of over 20,000 population where the per capita loss

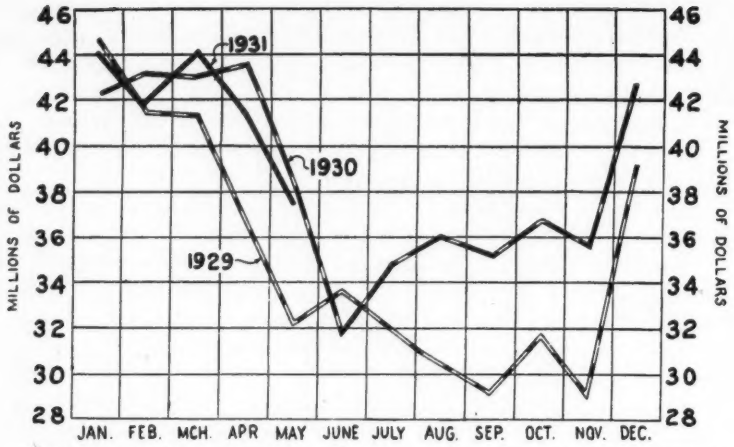

Chart of U. S. fire losses, plotted by months, compiled from figures of National Board of Fire Underwriters.

exceeded five dollars during the past year. In figuring per capita losses the losses have been adjusted to 1930 population figures.

Annual Fire Losses in the United States for Fifty-five Years.

Year	Property Loss	Year	Property Loss	Year	Property Loss
1875.....	$78,102,285	1894.....	$140,006,484	1913.....	$203,763,550
1876.....	64,630,600	1895.....	142,110,233	1914.....	221,439,350
1877.....	68,265,800	1896.....	118,737,420	1915.....	172,033,200
1878.....	64,315,900	1897.....	116,354,575	1916.....	258,377,952
1879.....	77,703,700	1898.....	130,593,905	1917.....	289,535,050
1880.....	74,643,400	1899.....	153,597,830	1918.....	353,878,876
1881.....	81,280,900	1900.....	160,929,805	1919.....	320,540,399
1882.....	84,505,024	1901.....	165,817,810	1920.....	447,886,677
1883.....	100,149,228	1902.....	161,078,040	1921.....	495,406,012
1884.....	110,008,611	1903.....	145,302,155	1922.....	506,541,001
1885.....	102,818,796	1904.....	229,198,050	1923.....	535,372,782
1886.....	104,924,750	1905.....	165,221,650	1924.....	549,062,124
1887.....	120,283,055	1906.....	518,611,800	1925.....	559,418,184
1888.....	110,885,665	1907.....	215,084,709	1926.....	561,980,751
1889.....	123,046,833	1908.....	217,885,850	1927.....	472,933,969
1890.....	108,993,792	1909.....	188,705,150	1928.....	464,607,102
1891.....	143,764,967	1910.....	214,003,300	1929.....	459,445,778
1892.....	151,516,098	1911.....	217,004,575	1930.....	499,739,132
1893.....	167,544,370	1912.....	206,438,900		

NOTE:—Previous to 1916 figures obtained from the records of the New York *Journal of Commerce*, deducting the Canadian losses. Subsequent years are based on returns to Actuarial Bureau of the National Board of Fire Underwriters, adding 25% for unreported and uninsured losses. The figure for 1930 is based on estimates made by the Actuarial Bureau.

For the most part the fire loss figures for cities are fire department estimates, and as such may be somewhat lower than those reported by the insurance companies. It is also to be noted that these figures may not, in all cases, be estimated on the same basis, and that they may in some cases be inconclusive if taken for a single city for a single year. This is particularly true in the case of the smaller cities, where a single large fire may materially distort the per capita figure. Nevertheless, the per capita fire losses are considered the best available index by which to compare the fire record of cities, and a high per capita fire loss continuing over a period of years is considered conclusive evidence of the true conditions.

Comparative U. S. Fire Losses.

	Whole Country			Cities of 20,000 Population or Over		
	Population	Total Loss	Per Capita	Population	Total Loss	Per Capita
1921..	108,540,838	$495,406,012*	$4.56	40,324,918	$141,406,007†	$3.51
1922..	109,955,947	506,541,001	4.62	33,821,476	120,964,112	3.57
1923..	110,663,502	535,372,782	4.84	42,946,639	147,102,119	3.42
1924..	112,078,611	549,062,124	4.90	43,375,796	146,222,749	3.37
1925..	115,378,094	559,418,184	4.85	45,297,469	160,011,951	3.53
1926..	117,136,000	561,980,751	4.80	53,243,778	178,178,874	3.35
1927..	119,320,000	472,933,969	3.96	51,291,549	144,618,641	2.82
1928..	120,013,000	464,607,102	3.87	51,836,000	140,038,116	2.70
1929..	120,700,000	459,445,778	3.81	53,411,000	145,059,043	2.72
1930..	122,775,046	499,739,132	4.07	50,206,000	150,981,223	3.01

*Estimated from Records of the Actuarial Bureau. †Figures reported by fire departments.

Per Capita Fire Losses of Cities Over 500,000 Population.

	1930 Population	1928	1929	1930	Three-year Average
New York, N. Y.....	6,981,900	$3.19	$3.54	$3.47	$3.40*
Chicago, Ill.....	3,375,300	3.85	4.75	4.48	4.36
Philadelphia, Pa.	1,964,400	2.73	2.86	2.72	2.77
Detroit, Mich.	1,574,000	2.34	2.64	2.74	2.57
Los Angeles, Cal.....	1,233,600	2.12	2.98	1.27	2.12
Cleveland, O.	900,400	3.22	3.42	4.26	3.63
St. Louis, Mo.....	822,000	3.34	2.41	2.58	2.78
Baltimore, Md.	804,900	1.89	1.87	2.84	2.20
Boston, Mass.	787,300	4.98	5.30	6.54	5.61
Pittsburgh, Pa.	669,700	1.70	2.18	1.70	1.89
San Francisco, Cal.†	637,200	...	...	...	...
Buffalo, N. Y.....	573,100	3.34	4.47	2.01	3.27
Milwaukee, Wis.	572,600	2.86	2.20	2.77	2.61

†Does not report its losses.

*These figures are based on losses paid in New York City by the subscribers to the Actuarial Bureau of the National Board. The fire department estimates for these years were considerably lower.

Cities from 400,000 to 500,000 Population.

	1930 Population	1928	1929	1930	Three-year Average
Washington, D. C.	486,900	$1.57	$2.37	$2.59	$2.18
Minneapolis, Minn.	464,800	3.75	2.71	3.25	3.24
New Orleans, La.	455,800	1.77	1.54	1.57†	1.63
Cincinnati, O.	449,300	2.60	2.04	1.74	2.13
Newark, N. J.	442,800	3.57	3.01	3.62	3.40

Cities from 300,000 to 400,000 Population.

Kansas City, Mo.	399,500	$4.59	$3.84	$3.69	$4.04
Seattle, Wash.	365,500	.99	2.80	2.15	1.98
Indianapolis, Ind.	364,000	3.48	3.66	2.66	3.27
Rochester, N. Y.	325,000	1.94	1.83	1.68	1.82
Jersey City, N. J.	315,600	1.01	.54	2.26	1.27
Louisville, Ky.	307,800	2.80	2.52	4.33	3.22
Portland, Ore.	301,900	2.78	2.85	2.55	2.73

Cities from 200,000 to 300,000 Population.

Houston, Tex.	292,300	$5.48	$2.70	$3.05	$3.74
Toledo, O.	290,800	2.56	3.61	2.98	3.05
Columbus, O.	289,000	1.65	1.22	1.22	1.34
Denver, Col.	287,600	1.46	2.06	1.84	1.79
Oakland, Cal.	284,200	1.50	1.58	2.65	1.91
St. Paul, Minn.	271,400	1.98	3.39	3.68	3.02
Atlanta, Ga.	270,400	3.23	2.69	6.73	4.22
Dallas, Tex.	260,400	5.74	5.62	6.65	6.00
Birmingham, Ala.	257,700	2.38	3.26	2.11	2.58
San Antonio, Tex.	254,600	1.39	.68	.94	1.00
Akron, O.	253,700	1.24	2.26	1.64	1.71
Memphis, Tenn.	253,100	2.52	3.08	5.53	3.71
Providence, R. I.	253,000	3.23	3.74	2.86	3.28
Omaha, Neb.	214,200	2.14	5.42	2.07	3.21
Syracuse, N. Y.	207,000	1.19	1.58	2.39	1.72
Dayton, O.	200,200	2.42	1.08	1.07	1.52

Cities from 150,000 to 200,000 Population.

Worcester, Mass.	196,800	$4.47	$5.38	$3.69	$4.51
Oklahoma City, Okla.	185,400	1.64	3.56	3.12	2.77
Richmond, Va.	182,900	.66	2.01	.84	1.17
Youngstown, O.	170,000	2.81	2.17	3.05	2.68
Grand Rapids, Mich.	168,700	2.07	1.11	1.00	1.39
Hartford, Conn.	164,100	1.71	2.35	3.12	2.39
New Haven, Conn.	162,700	5.05	3.29	2.78	3.71
Fort Worth, Tex.	160,900	3.91	9.64	5.57	6.37
Flint, Mich.	156,400	2.22	1.46	2.25	2.31
Nashville, Tenn.	153,200	8.88	8.11	5.89	7.63

†The New Orleans per capita loss figure for 1930 obviously does not include the two wharf fires which occurred during March, 1930, with a total loss of approximately $4,000,000.—Ed.

Cities from 125,000 to 150,000 Population.

	1930 Population	1928	1929	1930	Three-year Average
Springfield, Mass.	149,900	$2.41	$2.17	$2.15	$2.24
San Diego, Cal.	147,900	.82	.60	1.13	.85
Bridgeport, Conn.	146,700	.35	.87	.74	.65
Scranton, Pa.	143,400	3.37	3.65	2.71	3.25
Des Moines, Ia.	142,500	3.50	5.56	5.03	4.70
Long Beach, Cal.	141,500	1.83	.72	1.19	1.25
Tulsa, Okla.	141,300	1.95	.92	1.25	1.37
Salt Lake City, Utah.	140,200	3.16	1.64	2.90	2.57
Paterson, N. J.	138,300	5.46	4.83	8.99	6.43
Yonkers, N. Y.	135,100	1.73	2.26	1.78	1.92
Norfolk, Va.	129,700	2.60	3.17	3.11	2.96
Jacksonville, Fla.	129,400	2.82	1.57	3.23	2.54
Albany, N. Y.	127,400	3.77	3.20	2.56	3.28

Cities from 100,000 to 125,000 Population.

Trenton, N. J.	122,600	$3.92	$2.36	$1.77	$2.68
Kansas City, Kans.	122,300	1.52	1.47	1.00	1.33
Chattanooga, Tenn.	119,500	2.54	2.22	8.58	4.45
Camden, N. J.†	117,200	...	...	...	...
Spokane, Wash.	116,000	2.41	6.71	2.33	3.82
Erie, Pa.	115,900	.58	.68	1.09	.79
Fall River, Mass.	115,300	23.70	1.37	1.60	8.89
Fort Wayne, Ind.	114,900	.92	2.31	2.16	1.80
Elizabeth, N. J.	114,600	1.84	3.73	2.79	2.79
Cambridge, Mass.	113,700	4.34	3.61	7.57	5.17
New Bedford, Mass.	112,800	2.32	1.16	1.77	1.75
Wichita, Kans.	111,000	4.31	2.55	.68	2.51
Miami, Fla.	110,500	3.46	1.21	.94	1.87
Reading, Pa.	110,300	8.43	4.65	2.58	5.22
Tacoma, Wash.	106,900	6.12	2.19	6.09	4.80
Wilmington, Del.	106,600	.77	1.59	.89	1.08
Knoxville, Tenn.	105,800	1.83	1.34	3.57	2.25
Canton, O.	105,500	.91	1.96	2.60	1.82
Peoria, Ill.	104,800	3.18	3.58	2.50	3.09
South Bend, Ind.	104,200	1.59	2.95	1.81	2.12
Somerville, Mass.	103,600	2.51	2.25	3.86	2.87
Evansville, Ind.	103,200	4.49	1.57	5.68	3.91
Utica, N. Y.	102,700	3.02	4.16	4.86	4.01
Lynn, Mass.	102,300	4.93	3.94	3.89	4.25
El Paso, Tex.	102,000	1.39	3.49	1.18	2.02
Tampa, Fla.	101,500	4.18	2.75	1.51	2.81
Duluth, Minn.	101,400	3.76	3.78	4.61	4.05
Gary, Ind.	100,400	1.30	2.22	3.66	2.39
Lowell, Mass.	100,300	2.28	1.99	2.80	2.38

†Does not report its losses.

Cities in Which Losses Exceeded $5.00 Per Capita in 1930.

Nashua, N. H.	$77.75	*Lynchburg, Va.	$6.62
‡Everett, Mass.	20.02	†Lexington, Ky.	6.56
*Salem, Ore.	19.22	†Boston, Mass.	6.54
*New Albany, Ind.	15.38	Texarkana, Tex.	6.53
Hoboken, N. J.	13.71	*Waukegan, Ill.	6.43
*Harrisburg, Pa.	13.37	Portsmouth, Va.	6.39
†Belleville, Ill.	12.83	†Burlington, Vt.	6.19
*Gadsden, Ala.	11.83	†Chicago Heights, Ill.	6.18
Lubbock, Tex.	10.75	‡Peabody, Mass.	6.12
Holyoke, Mass.	10.55	Tacoma, Wash.	6.09
Rome, Ga.	9.04	†Haverhill, Mass.	6.07
†Paterson, N. J.	8.89	†Gloversville, N. Y.	5.95
Beloit, Wis.	8.75	**Nashville, Tenn.	5.89
Chattanooga, Tenn.	8.57	*Waco, Texas	5.84
Roanoke, Va.	8.08	Stamford, Conn.	5.81
*Charlotte, N. C.	7.91	Hannibal, Mo.	5.77
Newport, R. I.	7.86	Durham, N. C.	5.75
*Cambridge, Mass.	7.57	*East Providence, R. I.	5.71
White Plains, N. Y.	7.44	*Anderson, Ind.	5.69
Monroe, La.	7.41	*Evansville, Ind.	5.68
Little Rock, Ark.	7.34	*Meridian, Miss.	5.68
‡Atlantic City, N. J.	7.32	*Bradford, Pa.	5.64
‡Leominster, Mass.	7.21	Galesburg, Ill.	5.54
*New Brunswick, N. J.	7.01	Memphis, Tenn.	5.54
†Alexandria, La.	6.97	*Fort Worth, Tex.	5.51
Oil City, Pa.	6.93	†Gloucester, Mass.	5.45
Jackson, Tenn.	6.79	*Wichita Falls, Tex.	5.31
Atlanta, Ga.	6.73	Reno, Nev.	5.28
*New Castle, Pa.	6.73	Columbia, S. C.	5.25
†Elmira, N. Y.	6.71	Augusta, Ga.	5.16
North Little Rock, Ark.	6.65	Des Moines, Iowa	5.03
**Dallas, Tex.	6.63	‡Passaic, N. J.	5.02

*In this class in two of the last five years.
†In this class three of the last five years.
‡In this class four of the last five years.
**In this class five consecutive years.

Losses Slightly Lower for First Part of 1931.

The fire losses for the United States for the first five months of 1931 were $209,199,869, which is $1,381,636, or approximately 0.6%, less than for the same period last year, according to estimates prepared by the National Board of Fire Underwriters.

	1929	1930	1931
January	$44,713,825	$42,344,035	$44,090,449
February	41,520,290	43,206,940	41,776,051
March	41,277,814	42,964,392	44,074,362
April	36,845,795	43,550,996	41,423,764
May	32,129,408	38,415,142	37,835,273
Total—Five months	$196,487,132	$210,481,505	$209,199,869

Canadian Fire Losses, 1930.

Notwithstanding the widespread business depression of 1930 and the lower inventory values of all classes of merchandise, the total Canadian fire losses for the year 1930 dropped almost $1,400,000, or approximately 4 per cent, under the high loss year of 1929. On the other hand, the number of fires reported was substantially greater, being approximately 40,000 against 36,000 for the previous year.

Again, as in the year 1929, there were no fires involving a loss of a million dollars or more. There were, however, forty-one fires in which the loss exceeded $100,000. Among the larger losses were the following, involving individual losses in excess of $250,000.

Vancouver, B. C.	Canadian National Railway Wharf.....	$731,000
Thunder Bay, Ont.	Canadian National Railway Warehouse....	725,000
Mount Dennis, Ont.	Wool Warehouse	575,000
Ottawa, Ont.	St. Joseph's R. C. Church.....	418,000
Port Arthur, Ont.	Union Elevator	350,000
Toronto, Ont.	Hardware Store	298,000
Hébertville Station, P. Q.	Conflagration	286,000
Vancouver, B. C.	Warehouse	253,000

In contrast to the reduction in property losses during the year, the loss of life by fire increased approximately 38 per cent. The loss of life by fire in 1930 was 311 as compared with 233 in 1929.

The following tables, compiled from statistics furnished by the Dominion Fire Prevention Association, give a picture of the fire waste problem in Canada for the past few years.

A Decade of Fire Losses in Canada.

Year	Property Loss	Per Capita	Year	Property Loss	Per Capita
1921.....	$45,015,900	$5.22	1926.....	$38,295,096	$4.15
1922.....	54,390,000	6.11	1927.....	32,254,084	3.29
1923.....	48,282,000	5.36	1928.....	36,402,018	3.79
1924.....	45,906,500	4.99	1929.....	47,499,746	4.85
1925.....	40,729,724	4.35	1930.....	46,109,875	4.70

Municipal Group Classification, 1929-1930.

	1929		1930	
	Total Loss	Per Capita	Total Loss	Per Capita
Cities over 10,000 population.....	$15,212,790	$3.61	$14,643,570	$3.43
Towns 5,000 to 10,000 population.	2,159,713	5.38	1,963,095	3.92
Towns 1,000 to 5,000 population..	4,646,041	5.19	3,891,724	5.13
Villages under 1,000 population...	8,327,998	5.24	9,877,062	5.47
Rural districts	16,895,730	6.01	15,734,424	5.13
Not classified	256,974	...	.....	...
Total.....	$47,499,746	$4.85	$46,109,875	$4.70

Losses by Provinces.

	Estimated Population	Loss, 1929	Per Capita Loss, 1929	Loss, 1930	Per Capita Loss, 1930
Alberta	646,000	$3,800,000	$5.88	$2,963,191	$4.58
British Columbia	591,000	4,190,100	7.00	4,701,000	7.95
Manitoba	663,000	2,652,497	4.00	2,746,304	4.14
New Brunswick	419,000	1,890,275	4.51	1,942,885	4.63
Nova Scotia	651,000	1,637,137	2.97	1,614,393	2.48
Ontario	3,272,000	15,781,521	4.82	16,145,531	4.93
Prince Edward Island	86,000	710,319	8.25	235,944	2.74
Quebec	2,690,000	11,878,327	4.42	12,176,675	4.51
Saskatchewan	867,000	4,859,670	5.60	3,504,293	4.04
Not reported	.....	100,000	...	79,562	...
Total	9,785,000	$47,499,746	$4.85	$46,109,875	$4.70

Occupancy Group Classification, 1930.

Group	No. of Fires	Property Loss	Average Loss per Fire
Manufacturing plants	1,150	$10,203,522	$8,873
Mercantile establishments	3,676	11,471,834	3,120
Residential property	24,103	11,625,274	482
Farm property (other than dwellings)	3,962	5,002,146	1,262
Garages	930	1,638,728	1,762
Churches, presbyteries and chapels	182	1,066,630	5,870
Schools, colleges, academies and convents	246	658,484	2,680
Hospitals, sanatoria and homes	66	148,966	2,260
Miscellaneous property	4,802	4,289,291	894

Origin of Fires in Canada, 1930.

Causes Reported	No. of Fires	Causes Reported	No. of Fires
Smokers' carelessness	5,042	Hot ashes and coals	987
Carelessness with matches	4,865	Exposure	805
Stoves, furnaces and pipes (overheated or defective)	4,599	Open fires	744
Electrical defects and appliances	2,433	Spontaneous combustion	713
Sparks on roofs	2,232	Portable lamps and lanterns	709
Lightning	1,572	Miscellaneous known causes	608
Coal oil and gasoline	1,269	Supposed incendiary	277
Defective chimneys and flues	1,237	Fireworks	246
		Unknown causes	9,281
		Total	39,117

Fatalities by Fire, 1925-1930.

Year	Men	Women	Children	Total
1925	84	92	171	347
1926	79	86	123	288
1927	86	107	272	465
1928	51	84	179	314
1929	47	65	121	233
1930	53	91	167	326
Total	410	515	1,033	1,958

Fire Losses—Great Britain and Ireland.

Statistics compiled by *Fire*, the official journal of the British Professional Fire Brigades Association and official record of the British National Fire Brigades Association, indicate a marked reduction in the fire losses of the United Kingdom in 1930.

Annual Fire Losses—Great Britain and Ireland.

1921*	£9,316,800	1926†	£8,726,300
1922*	9,395,880	1927†	7,893,240
1923*	13,019,400	1928†	10,628,470
1924*	8,939,080	1929†	15,617,471
1925†	9,012,740	1930†	10,520,540

*Figures for 1921 to 1924 inclusive were taken from the London *Times*, with 20% added for small and unreported losses. †Figures for 1925 to 1930 inclusive were obtained from *Fire*.

Losses by Months—Great Britain and Ireland.

	1926	1927	1928	1929	1930
January	£297,500	£413,000	£928,200	£1,479,300	£1,213,800
February	1,428,700	581,000	435,400	1,090,280	965,000
March	604,380	431,900	540,680	2,120,800	1,010,100
April	892,800	759,500	693,100	1,512,700	758,800
May	228,060	507,745	1,310,400	1,661,800	466,200
June	792,400	676,900	508,340	1,322,900	543,200
July	457,000	780,500	1,040,200	1,366,400	625,500
August	947,100	604,800	1,104,500	1,561,000	608,300
September	528,200	635,600	1,039,500	982,100	1,883,840
October	866,600	325,940	1,941,100	1,121,750	423,500
November	577,300	655,000	532,700	716,100	1,243,200
December	1,037,400	1,743,200	560,800	694,141	779,100
Total	£8,726,300	£7,893,240	£10,628,470	£15,617,471	£10,520,540

Comparative National Fire Losses.

The losses of Great Britain and Ireland, Canada, and the United States for a ten-year period are given below in parallel columns. For comparison the losses of Great Britain and Ireland have been reduced to dollars.

	Great Britain and Ireland		Canada		United States	
	Total Loss	Per Capita	Total Loss	Per Capita	Total Loss	Per Capita
1921	$45,200,000	$1.02	$45,016,000	$5.22	$495,406,000	$4.56
1922	46,100,000	1.04	54,391,000	6.11	506,541,000	4.62
1923	63,250,000	1.43	48,282,000	5.36	535,373,000	4.84
1924	43,400,000	.97	45,907,000	4.99	549,062,000	4.90
1925	43,800,000	.99	40,730,000	4.35	559,419,000	4.85
1926	42,410,000	.96	38,295,000	4.15	561,980,000	4.80
1927	38,361,000	.87	32,254,000	3.29	472,933,000	3.96
1928	51,654,000	1.17	36,402,000	3.79	464,607,000	3.87
1929	75,901,000	1.72	47,499,700	4.83	459,446,000	3.81
1930	51,125,428	1.27	46,109,900	4.70	499,739,000	4.07

City Planning and Fire Prevention.

By Henry C. Klein (Member N.F.P.A.),
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City planning is the ancient science of controlling and guiding the physical development of cities, towns and villages in the interest of public welfare. It has had a comparatively recent renaissance, in the process of which zoning has been included as a part of city planning, although popularly classified as a separate science. In this discussion the term city planning is used in its popular sense to refer only to the orderly regulation of the physical growth of municipalities, exclusive of modern zoning, which in this country dates from the adoption of a zoning law by the City of New York in 1916. Zoning is the regulation of the height, bulk, location, set-back and use of privately owned and occupied buildings, the control of density of population, and the use of private land.

As the construction of buildings and the purposes for which they are used involve consideration of fire hazards, prevention and protection, individuals and organizations interested in fire protection have devoted considerable attention to zoning. Judging from the scarcity of library material on the interdependence of fire protection and other phases of city planning, however, students and writers on both subjects have not associated them to any appreciable extent. It is therefore the purpose here to briefly analyze the non-zoning features of city planning from the fire protection viewpoint, in the hope that city planning and fire protection engineers may realize their greater common interest and the need for coöperation.

Zoning and Planning Laws.

There are, at the present time, at least 981 municipalities in the United States with zoning ordinances which are generally based upon the police power of the state, upheld by the United States Supreme Court, to regulate the height, bulk, location, and use of privately owned buildings and land "for the purpose of promoting the health, safety, morals, or the general welfare of the community," as the New York law expresses it. That law, which is typical of the laws of other states, also provides that "such regulations shall be made in accordance with a comprehensive plan and designed to lessen congestion in the streets; to insure safety from fire, panic or other dangers; to promote health and the general welfare; to provide adequate light and air; to prevent the overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks and other public requirements."

The same law, in authorizing planning boards, of which there are now at least 787 in the United States, provides that official maps or plans of munic-

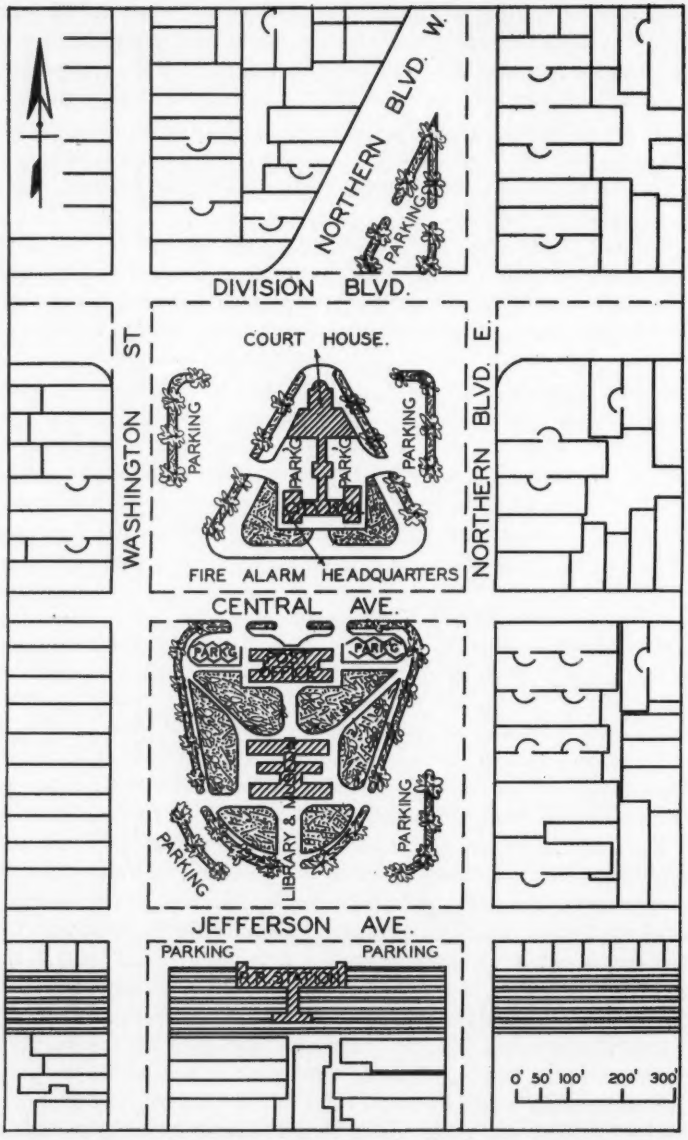
ipalities showing existing streets, highways and parks, be established "to conserve and promote the public health, safety, and general welfare." Upon such maps planning boards may place new subdivisions or plots, new parks and new streets, requiring that the latter be of sufficient width and suitable location "to accommodate prospective traffic and to afford light, air and access of fire fighting equipment to buildings." Considerations of health and the prospective character of the development, whether residential, business, or industrial, must also be observed.

Probably taking their cue from the comparatively brief reference thereto in state laws, city planners appear to have greatly subordinated considerations of municipal fire defense in their master or comprehensive plans. Indeed there are such plans in which there is no reference whatever to fire protection. Fortunately, however, in striving for the conservation and promotion of public health, safety and general welfare, city planners have unconsciously in many instances devised plans which, wholly or partially, embody good fire protection practice. With the thought therefore of suggesting some items which should be of mutual interest to city planners and fire protection engineers, and with the hope that as a result future community plans will stress good fire protection as a desideratum and one of the objectives sought, the following features of the typical master or comprehensive plan of a municipality are briefly analyzed.

Streets, Highways, and Boulevards.

City planners are primarily concerned with streets and highways,—that they shall be well paved, of ample width, with light grades, and without dangerous crossings, curves, and dead ends. Such concern is readily understandable from the viewpoint of securing ample light and air, and freedom from traffic accidents and congestion; this is manifestly of benefit to the health of the people as well as ministering to the business and industrial prosperity without which the average community cannot exist.

But streets and highways are also the channels through which fire protection is distributed to residences, stores, and factories. Narrow streets cause not only traffic congestion and parking evils, but also greatly increase the time required to move and the difficulty of maneuvering fire apparatus to best advantage, as well as seriously preventing access to hydrants and the speedy stretching of hose lines. By-passes and circumferential routes to take through traffic around congested business districts, are, for the same reason, good for fire protection as well as good city planning. Dead end streets, especially such as terminate at the boundary lines of municipalities, not only reduce property values and prevent access for social and business purposes, but they are also attended by dead end water mains with reduced pressures, and handicap exchange of fire fighting services between municipalities in time of need for outside aid. Heavy grades, bad curves, and railroad crossings not only slow



An assumed civic center plan designed for beauty, park space, and wide boulevards, assuring relief from traffic and parking problems in a congested business district. The dotted lines indicate original narrow streets. Note how the district is divided into separate fire areas, and public buildings protected against conflagration. Courageous city planning is expensive, but pays.

up pleasure and business traffic and increase accidents, but such features are the cause of much anxiety to the fire chief, who must operate his apparatus in all kinds of weather and conditions of pavements. He is virtually helpless when a long freight train bars his way at a grade crossing, and can but rage at steep grades such as handicapped fire fighting in the Mill Valley, California, conflagration in July, 1929, when fire engines were compelled to climb narrow mountain roads and stretch hose lines up a steep hillside for 3000 feet.

Boulevards (streets that have grown up) are the delight of the city planner, who visualizes wide roads flanked and/or bisected by verdant lanes, bringing light, air and rapid movement of traffic. Boulevards are also desired by fire protection engineers, who see in them conflagration stops dividing municipalities into fire divisions as well as greatly facilitating the movement of fire-fighting apparatus. And while the city planner seeks to cut up long blocks into lengths not exceeding 800 feet to secure accessibility, the fire protection engineer registers his approval of short blocks as conflagration preventives, especially when frame rows and combustible construction predominate.

Parks, Playgrounds, and Civic Centers.

As the city planner knows that busy streets are not safe for children and that recreation is a modern necessity for old and young alike, he provides for parks and playgrounds. Some of these he locates in congested districts, readily accessible to the children who are in greatest need of play areas. He probably does not consider the value of such open areas from a conflagration standpoint, yet such value cannot be overestimated, and when fully appreciated will influence the location and size of such areas.

With the problems of streets, highways and parks of the municipality settled, the city planner turns to the creation of a civic center in which are to be placed public and semi-public buildings, constructed and arranged with an eye to dignity and beauty, secured by restriction as to height, set-back, type of architecture and open spaces. Such a center manifestly increases civic pride as well as efficiency in government. If the construction is thoroughly fire-resistive and the open spaces are ample, the permanent gain in assurance against damage to valuable records and interruption of governmental functions, even though a conflagration should lay waste the surrounding territory, will demonstrate the value of coördinated city planning and fire protection engineering. To similarly protect the nerve center of a municipality's fire defense, the city planner will do well to include the central fire alarm station as a part of his civic center if thoroughly fire-resistive and unexposed, or will place the station in an isolated location, such as a park, where appropriate architecture will satisfy all the aesthetic requirements of city planning.

The city planner will do well to place the central fire alarm station in an isolated but central location, such as a park. This picture shows the Worcester, Mass., fire alarm central station.

Water Supply and Overhead Wires.

As an abundance of water supply is necessary for fire protection as well as general use, water pumping stations must serve much more than the beauty which the city planner has in mind for other public buildings. City planners and fire protection engineers should coöperate to secure volume of water and pressure adequate for business, industrial, and residential districts for at least twenty-five years, going far afield if necessary to secure ample watershed reservations. In this search they will contact with regional planning, which is city planning applied to city environs.

The thought of water suggests other public utilities, such as telephone and electric light and power, which are manifested by a multiplicity of overhead wires and poles. Because of their unsightliness, such wires offend the aesthetic sensibilities of the city planner, but the fire protection engineer fears them because of the more practical reason of the serious obstruction they present to effective fire fighting, especially when high potential currents are carried. If a recommendation in the master plan calling for underground conduits is stressed because of fire protection as well as aesthetic reasons, the request for elimination of overhead wiring will be strengthened.

Fire Stations, Bridges, Waterfronts.

Fire department stations, being municipal buildings, appear in master plans as structures for which locations and adequate funds must be provided. There is insufficiency of evidence, however, to indicate that the determination of locations for such stations comprehends such considerations as the proper distance between these stations and every point in present and future high

value and high hazard business and industrial, as well as residential, districts as prescribed in the "Standard Schedule for Grading Cities and Towns of the United States with Reference to their Fire Defenses and Physical Conditions" of the National Board of Fire Underwriters. The desirability of locating fire stations on level crosstown thoroughfares instead of on narrow side streets or on heavy grades, all with due regard for climatic conditions and with the view to expediting response to fire alarms, is also a consideration which city planners seem to have overlooked.

Bridges may appear to be simply problems for the designing engineer, influenced by the city planners' commendable desire for beauty as well as utility. To fire protection engineers, however, bridges are a means of moving fire apparatus, and therefore a drawbridge, for example, is an abomination as likely to be responsible for the loss of precious time by fire apparatus speeding to a blaze.

Waterfront developments, too, have their fire protection problems, involving construction, adequate separation of docks and piers, and adequate private as well as fireboat protection. These are quite as important as planning considerations for supplementary rail and highway facilities, accessibility, and channel depth. In addition to zoning and the foregoing items of common concern, city planners and fire protection engineers have a mutual interest in building codes, and in fire limits within which no wooden construction or wood shingle roofs should be permitted.

Paying the Cost.

No master plan is complete without a long term budgeted program for providing the funds for completing the improvements recommended, thereby giving effect to the plan. The city planner's task is not finished until he has formulated a budget and virtually sold his plan to the taxpayers before whom it must pass the acid test of whether the municipality can, even over a period of twenty-five years, finance the carrying out of the plan. It is here that the fire protection engineer of the fire insurance rating bureau having jurisdiction can be of considerable assistance, because he is in a position to appraise the fire insurance rating value of improvements in municipal fire defenses. He can compute with reasonable accuracy the saving in fire insurance premiums which will follow upon the completion of improvements which, if they have been made in accordance with the requirements of the National Board of Fire Underwriters, will reduce fire rates.

A master plan can be ever so fine and impressive, with attractive maps and pictures of the dream city of the future, but unless the average taxpayer is shown that it will bring tangible returns, such as reduced fire insurance premiums, he is difficult to interest. Bearing in mind that the enormous annual cost of fire waste in lives and property and the cost of fire fighting

weigh very heavily upon our municipalities, city planners and fire protection engineers will be well advised if they avail themselves of the mutual assistance they can offer each other.

City Planning a Vital Civic Force and Challenge.

City planning is unquestionably demonstrating its value as it spreads throughout the nation. It prevents the costly mistakes of haphazard growth by bringing about order in the physical development of communities and in anticipating future community needs. It creates and conserves property and business values, and prevents exploitation by unscrupulous builders and realtors. City planning benefits communities socially, politically, culturally, and aesthetically, and has been well said to be "the most vital modern civic force combating our ever growing evils of crowding, congestion, and ugliness." City planning presents a challenge to all community minded citizens, but especially to city planners and fire protection engineers to take full advantage of their opportunities for coöperation in the interest of community safety and welfare. The result will assuredly be more effective work in their respective fields, so that both may be the better enabled to say, as did the young men of Athens of old in their oath, "Thus, in all these ways, we will transmit this city not only not less, but greater and more beautiful than it was transmitted to us."

Roadside Weed-Burning in California.

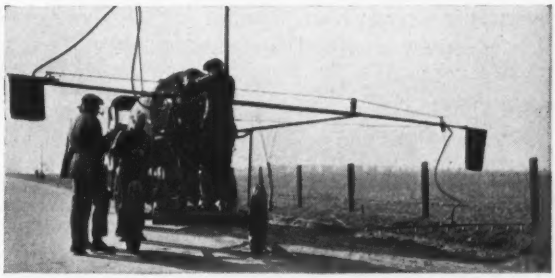
Engineering News Record.

Oil spraying followed by controlled burning is employed for weed removal to reduce the fire hazard along California highways. A definite program for this fire prevention work was begun in 1928, when burning was done along 660 miles of highway. Following an increased schedule in 1929, the program outlined for 1930 called for burning 1,020 miles of highway right-of-way at an expenditure of about $75,000. The work last year was done with a much improved type of spraying outfit developed by the headquarters equipment department of the division of highways and illustrated by the accompanying views.

The spraying unit consists of a 1,000-gal. tank truck and a two-wheeled trailer carrying the pumping and spraying equipment. A centrifugal pump driven by a small gasoline engine draws oil from the truck tank and discharges it through a ½-in. rubber hose to spray nozzles in a 9-ft. section of pipe, which is suspended from a light cantilevered frame. Control of the position and elevation of the spraying arm is governed by the operator standing on the platform of the trailer.

Diesel oil is used at a rate of approximately 0.1 gallon per square yard. The speed depends on highway conditions, but 9-ft. strips on both sides of an

Weed-killing unit of tank truck and oil sprayer.



Rear view of oil-spraying pump and sprayer head.

8-mile road have been processed in a day. After a week to ten days the vegetation has withered and dried and is ready for burning. This is carried on under traffic control because of the possible hazard of smoke on the highway, and it costs $20 to $30 per mile, depending on the amount of control required. Consent and aid of the property owners are secured before burning; upon the owner's refusal, burning is omitted, since it is believed that the state is not warranted in assuming a responsibility in creating a benefit which applies solely to the owner.

The work is done in the spring when the adjacent vegetation is still green, and plans call for its completion before the end of March. Selection of roadsides to be burned involves a consideration of the bordering lands, preference being given to grain fields, grazing lands and heavy brush in the drier sections of the state. Although the primary purpose of the program is to provide a fire break between fires originating on the highways and the adjacent land, it is the policy of the department to coöperate with any farmer who desires to keep his property free from weeds by cleaning up the right-of-way in front of his property.

The Norfolk Conflagration.

Report by South-Eastern Underwriters Association,
(Member N.F.P.A.).

A fire starting on a pier on the waterfront at Norfolk, Virginia, on Sunday afternoon, June 7, 1931, swept across five adjoining piers and wharves and destroyed or seriously damaged some sixty other buildings in the wholesale district. Fanned by a stiff southerly wind, the fire spread with great rapidity, and the fire department, aided by equipment from near-by cities and towns, had difficulty in coping with it. The loss was first placed at $3,000,000, but later estimates place it at approximately $1,250,000.

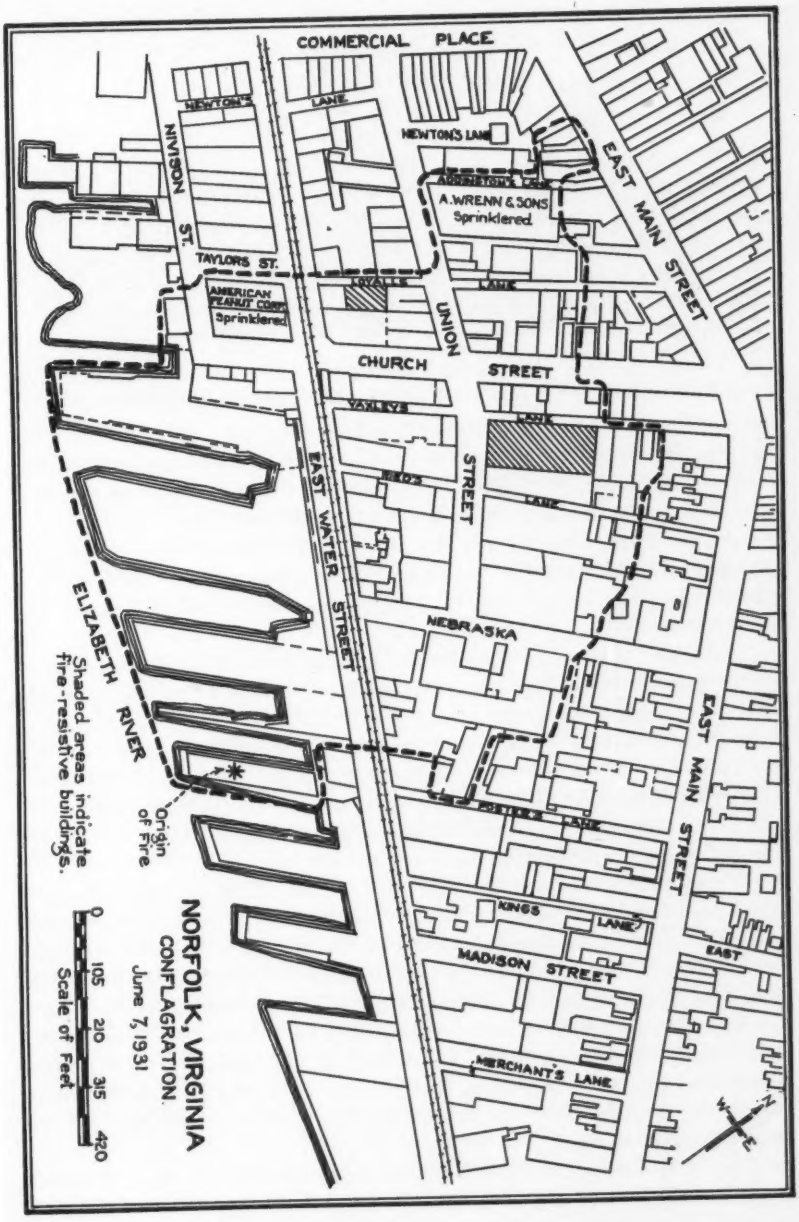
Property Involved.

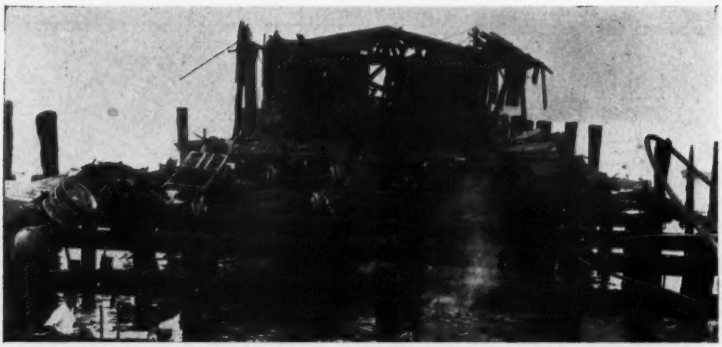
The property involved in the fire consisted of a frame metal-clad wharf, three large frame pier sheds and approximately sixty other buildings in the adjacent wholesale and light manufacturing district. These latter buildings consisted principally of old one to five-story brick ordinary joisted buildings, interspersed with a few frame or frame metal-clad structures or walls. Two fire-resistive structures, one small and one large, were involved with little damage to either. Two of the buildings severely damaged were protected by automatic sprinklers. In addition, a number of other structures suffered minor fire, water or smoke damage.

Origin of the Fire.

It has been definitely established that the fire originated in a frame metal-clad wharf, known as Duvall's Wharf, located just east of the Old Dominion S. S. Co. piers. This wharf had but recently been occupied by the Caroline Lines, Inc., as a freight truck depot for the storage of general merchandise awaiting shipment. This concern was said to be using a portion of this wharf as a garage for their trucks without the proper permit from the city authorities. An examination of the ruins disclosed the remains of several automobile trucks stored on the wharf.

The fire was first noticed by Captain Haas of the fireboat *Vulcan*, from the fireboat's quarters which are located almost directly opposite the scene of the fire on the south bank of the Elizabeth River. He saw smoke and flame issuing from the peak of the roof of the wharf at the south end and immediately telephoned an alarm to fire alarm headquarters. There are several witnesses to the location of the initial blaze and all bear out the above information. These include the toll collector on the Berkeley bridge and three men in a stalled motorboat on the river in the vicinity. At the same time an unknown person discovered the fire from the land side, and an alarm was received from Box 22 at Water and Nebraska Streets before the fireboat could leave its berth.


COMMERCIAL PLACE
NEWTON'S LANE
EAST MAIN STREET
A. WRENN & SONS
Sprinklered
TAYLOR'S ST.
AMERICAN PEANUT CORP.
Sprinklered
NIVISON ST.
UNION CHURCH STREET
EAST WATER STREET
NEBRASKA
ELIZABETH RIVER
Origin of Fire
Shaded areas indicate fire-resistive buildings.
KINGS LANE
MADISON STREET
MERCHANT'S LANE
NORFOLK, VIRGINIA
CONFLAGRATION.
June 7, 1931
105 210 315 420
Scale of Feet



Point of origin of the Norfolk conflagration of June 7, 1931. An examination of the ruins disclosed the remains of several automobile trucks. The wharf is said to have been used as a garage without proper permit from city authorities.

Story of the Fire.

The first alarm from the above mentioned street box was received at 5:30 P.M. The fireboat reached the scene before the land apparatus and immediately went into action with four turret nozzles varying in size from 2½-inch to 4-inch, and also laid one line of 3-inch hose from the boat along the west side of the wharf. The land apparatus responding on the first alarm, consisting of four engine and two truck companies, immediately laid lines on Water Street.

According to the weather bureau the wind at the time of the fire could be classed as a "fresh" south wind, and the velocity from the time the fire started until it was under control varied from 20 to 26 miles per hour. This wind was a factor in the spread of the fire across Water Street and to the group of Old Dominion piers at the same time. Water Street at this point is 50 to 60 feet wide. The distance between Duvall's wharf and the Old Dominion piers was 60 to 140 feet, with an open plank wharf intervening. At the time of the fire a vessel was in the adjacent slip.

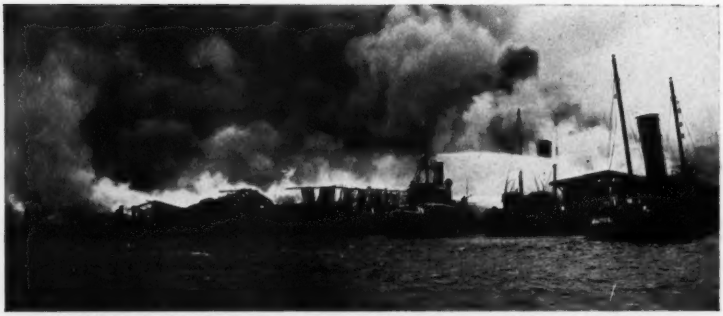
As soon as it was apparent that the fire was gaining headway a second alarm was sounded. This was at 5:46 P.M., and it was followed by a third alarm at 5:55 P.M., bringing the greater part of the city's fire-fighting equipment and summoning practically all the men off duty. Calls for outside aid were sent out and apparatus and men responded as follows: Portsmouth, Va., three pieces; South Norfolk, one piece; Norfolk Navy Yard, two pieces; Newport News, two pieces; Craddock, one piece; U. S. Naval Base, two pieces; Elizabeth City, N. C., one piece. In addition, tugs were sent from the Navy Yard and a number of private concerns, which rendered considerable assistance on the water side of the fire.

In the meantime, as the fire progressed, the fireboat *Vulcan* was forced to retire from its original position on the west side of Duvall's wharf and take

A fresh south wind drove the fire from its point of origin on Duvall's Wharf across the slip to the Old Dominion piers, which were completely destroyed. A boat in the slip was ignited and badly damaged.

a position along the west side of the Old Dominion piers in the rear of the American Peanut Company plant. Here an attempt was made to fight the pier fire with turret streams and land lines. About 7:00 P.M. the American Peanut plant became involved on several floors and the roof at the same time. Although equipped with automatic sprinklers, this plant was a total loss, for the sprinklers had little or no retarding effect on the fire. This was largely due to the heavy draft on the street mains in the vicinity for hose streams and the fact that the fire pump at the plant, supplied from city mains, was not automatic in operation and was inaccessible early in the fire. The efforts of the *Vulcan* and several pieces of land apparatus were of little avail in preventing the destruction of this property, but the *Vulcan's* land streams did prevent the fire from spreading further westward. The *Vulcan* kept this position for the next two days.

On the land side the fire department was greatly hampered by intense heat and heavy smoke blown toward them by the wind during the early stages of the fire. There were a number of explosions, the earliest occurring in the Old Dominion piers, a portion of which were used for the storage of acetylene and oxygen in cylinders and calcium carbide in drums. The cylinders for the most part vented through the safety release at the top, but fragments of some of the carbide drums were found scattered about in the ruins. The gasoline in tanks of automobiles and trucks destroyed in the fire no doubt also contributed to the explosions. The intensity of the heat may be realized in the destruction of a railroad box car loaded with furniture which was on a track in the middle of Water Street. This car was completely consumed ten minutes after its ignition, and the heated air carried the ashes away as brands so thoroughly that the ground around the car was as clean as if it had been swept. At about this time the pumper of Engine Co. 5, which was stationed at a hydrant not far distant from the car just mentioned, was destroyed.

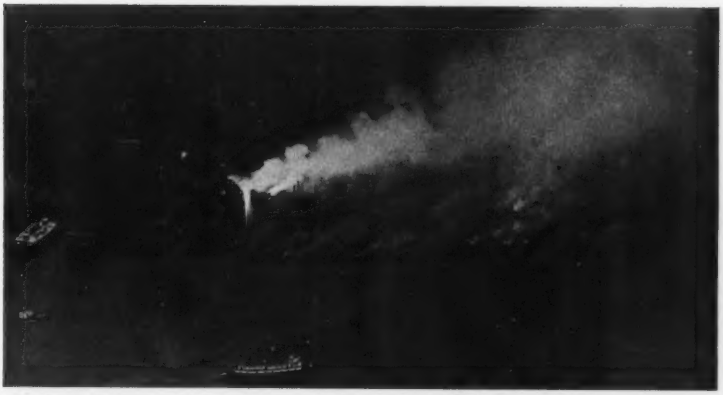


The fireboat "Vulcan" was early on the scene and attacked the fire from a position in the slip between the wharf of origin and the adjoining pier. Little could be done to stop the progress of the fire in spite of the powerful turret pipe streams supplied by the boat.

The fire spread quickly into the blocks on both sides of Church and Nebraska Streets, through to Union Street and about halfway of the block towards Main Street. On the north side of Union Street, just east of Church Street, was a large five-story fire-resistive structure having blank walls on the east, north and west sides, and approved wired glass windows on the south side. This building formed a very effective barrier and came through the fire with little damage other than badly spalled walls on the east and west and a damaged column and wall in the southeast corner. The wired glass windows were not damaged to any great extent. Although the fire was intense on the east and west sides and there was some fire on the north of the building, it is believed that this building had a great deal to do with preventing the spread of the fire northward in this block. In this same block, about halfway up along the west side of Nebraska Street between Union and Main Streets, an open junk yard and a vacant lot stopped the fire before it spread to a mission hotel located on the corner of Main Street and Nebraska Street.

In the block between Nebraska Street and Foster's Lane, north of Water Street, the fire was halted after partially destroying S. R. White's Sons, Inc., farm implement factory, and after it had spread through the Commonwealth Storage and Ice Company plant, but without damaging the Rosedale Dairy to the east of the latter plant. The firemen were aided here by a narrow alley and the fact that the wind abated, as described below. On the west side of Church Street the fire cut a path as far west as Loyall's Lane and about halfway of the block north of Union Street. Here it was halted in its northward course by the fire department, aided by the abatement of the wind, but not before the blaze had swept across Loyall's Lane to the west, north of Union Street.

Shortly after 11:00 P.M. a rain began to fall which continued throughout the night until 7:00 A.M. This amounted to .46 inch and, according to the



International.

Aerial view of Norfolk conflagration, showing piers and wharves destroyed. The fireboat "Vulcan" may be seen directing streams on the burning building of the American Peanut Corporation.

weather bureau, immediately after the rain started the wind changed and blew from the west in the proportions of a "squall" for about six minutes and then abated and shifted, blowing from the southwest and abated to the proportions of a light wind. This condition continued throughout the night and greatly aided the firemen. Chief Baughan stated, however, that his department had the fire under control before the wind changed.

Soon after midnight fire broke out in the sprinklered portion of A. Wrenn & Sons, Inc., located on the north side of Union Street between Marsden's Lane and Addington's Lane. The five-story brick joisted portion and the frame, metal-clad tank and elevator tower were involved. This fire was fought successfully with hose lines and sprinklers, and damage was confined to these two portions, although heavy water damage resulted throughout the building. The open sprinklers on the east were not used nor would they have been of any value, as the fire was undoubtedly communicated to this building by means of sparks and burning brands, as the fire chief told of putting out several fires here throughout the night. Some sprinklers operated and no doubt aided the firemen, but the effectiveness of the sprinkler system was decreased by the collapse of the gravity tank early in the fire, leaving a low pressure supply from street mains.

The conflagration was halted just south of the Majestic Theatre and the Victoria Hotel. Had it extended into these two buildings it is believed that the fire would have crossed Main Street. The only major fire damage in the buildings facing the south side of Main Street was in two small mercantiles located between Addington's Lane and Commercial Place. These outbreaks were readily extinguished by the fire department. Damage resulted to frame window trim in a few instances along the north side of Main Street, and

Looking across the fire-swept area of Norfolk toward the waterfront. The ruins in the foreground are indicative of the warehouse construction typical of the district.

International.

General view of the Norfolk fire, showing the devastated area in the heart of the wholesale district. Aided by a shift in the wind, the fire was brought under control before it reached the high value district in the foreground. Note large fire-resistive structure in center, which proved an effective fire barrier.

brands fell and ignited awnings and frame window trim as far north as the south side of Plume Street. Burning brands were said to be falling, prior to the rain, as far as eight to ten blocks north of the scene of the fire.

A great deal of credit must be given to the coöperation between the Norfolk Fire Department and the out-of-town aid in the effective fire fighting under adverse circumstances. At no time did the fire-fighting forces become in any degree demoralized, and the calls for equipment at different points were efficiently handled. Through the efforts of Chief Baughan all the hose threads in this vicinity have been standardized, with the exception of Newport News, and adapters were available for these couplings. Thus out-of-town companies could go into action without delay. The Navy responded with 500 men to aid the fire fighters, and the Marine Corps threw out a guard for the fire area. No lives were lost, although about forty men were injured or affected by the smoke and heat, twenty more or less seriously.

Operation of Sprinklers.

Two properties, that of the American Peanut Corporation and a building occupied as a body factory and body repair shop for automobiles together with a salesroom for the display of farm implements, were equipped with automatic sprinklers. The operation of these sprinklers was unsatisfactory, due to the severity of the exposure, the combustibility of the buildings, and the heavy draft on the city water system by fire department pumpers.

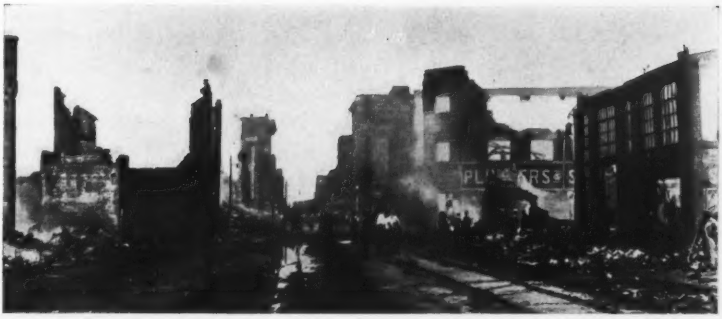
The first sprinklered property to become involved was the warehouse and factory of the American Peanut Corporation. This property consisted of a five-story brick ordinary joisted building having exterior openings protected against exposure by sub-standard fire shutters, except two openings on the east and all openings on the north and south sides. The east and west walls were not parapeted above the roof. The building was divided into two poor fire divisions by a non-standard brick fire wall having non-standard fire doors at openings.

This structure became involved at about 7:00 P.M. after the fire had assumed the proportions of a conflagration and completely out of control. According to eyewitnesses the fire appeared on the roof over the south parapet and along the Church Street side at about the same time, although fire had undoubtedly also communicated through the unprotected openings in the south wall. The heat from the adjacent burning piers was so intense that as soon as burning brands struck the roof it appeared to burst into flame all over. The building was quickly consumed and was on fire on every floor by the time the roof caved in.

The sprinklers apparently had no effect in checking the fire and it is doubtful if they operated to any degree of success at any time during the fire, as the tank (the only automatic supply) collapsed early in the fire, even before the roof caved in. The location of the fire pump and the fact that it was not automatic in operation would have made it impossible to use this equipment even if there had been any water available in the city mains after the heavy draft put upon them by the pumpers operating in this area.

Had adequate protection against a severe exposure fire, together with an automatic secondary source of water supply been provided, it is reasonable to assume that this loss would have been smaller. It is realized that even with this protection the roof and upper story would have sustained heavy damage, but the sprinklers would have had some chance to check the progress of the blaze through the rest of the building and would have materially aided the fire department.

As it was, a considerable portion of the fire department, including the fireboat, was concentrated at this point. The land apparatus, however, was forced to retreat on account of the heat and smoke, and little could be done to prevent the building from being a total loss.



International.

View looking westward along Water Street after the conflagration had spent its force. At the left are the still smoking ruins of the American Peanut Corporation. To the right are warehouses at the corner of Water Street and Yaxley's Lane.

The other sprinklered property involved was a five-story brick building of ordinary joisted construction. It was occupied by A. Wrenn & Sons, Inc., as a body factory and body repair shop for automobiles, and by the Norfolk Farm Supply Company as a salesroom for the display of farm implements. This building had exterior openings unprotected, walls were parapeted above roof on all sides except the east, and the eave on this side was protected by open sprinklers. Attached to this building was a tank and elevator tower seven stories in height of frame metal-clad construction throughout.

It is thought that this property became involved at about midnight at the time the fire was practically under control. Just how it caught has not been determined, but it would have been a simple matter for the elevator and tank tower to have become ignited from flying brands in the unsprinklered area at the top, and the building was exposed by the fire in the buildings owned by the same company across Marsden's Lane. It is impossible to tell whether the open eave sprinklers operated or not, but it is doubtful if they were used. Their value would have been slight due to the low water pressure and the heavy draft on the mains. A great many heads opened in building No. 2 and several in building No. 3, but it is doubtful if they accomplished much in checking the fire, as the tank must have fallen early and the city supply was obviously inadequate.

The fourth and fifth floors of building No. 2 were completely gutted, and the roof collapsed. The tank and elevator tower were completely wrecked, and the tank fell to the first floor, inflicting some damage to the roof of building No. 3. The entire property suffered heavy water damage from hose streams and sprinklers operating.

Adequate protection against a severe exposure fire such as might be expected in this section of the city was not provided. The only protection

View of Norfolk fire ruins at Church and Union Streets. The fire-resistive building in the foreground was an effective fire barrier, and equipped with wired glass windows in metal sash on the exposed side it suffered no damage.

against the heaviest exposures consisted of a line of open heads under the eaves on the east, which were handicapped by a poor water supply of low pressure and no pumping connection. The inside sprinklers had little chance after the collapse of the tank, which must have occurred early, and only the good work of the fire department saved the remainder of this plant.

Loss.

The total property loss is estimated to be approximately $1,250,000, involving an approximate insurance loss of $1,000,000. This figure is somewhat less than the preliminary estimates, which ranged from $2,000,000 to $5,000,000.

Conclusions.

This fire serves to emphasize further that which has already long been known, that the maintaining of large frame waterfront properties, which have long ago lost their intended usefulness, adjacent to high value wholesale and manufacturing districts, invites just the disaster which occurred here. This area has long been recognized as a conflagration district, and the actual disaster only bears out what has long been predicted. The original fire could have started from a number of causes, such as spontaneous ignition, electric wiring defects, or a short circuit in the ignition system of one of the several automobile trucks stored in the wharf. Starting as it did, on Sunday afternoon, it is not remarkable that nearly the entire wharf was on fire before the fire was discovered, as there would ordinarily be but a few people in this vicinity at this time. Hampered as they were by the wind and smoke, the fire department made a strong fight. For a time it appeared to observers that a great deal of the mercantile area of the city would be involved in spite of all efforts.

The fire clearly illustrates that even with the utilization of all available fire-fighting forces and off-shift men in the immediate vicinity of Norfolk, the conflagration hazard was present at all times throughout the fire on account

of the intensity of heat generated by the burning of the waterfront structures. The buildings immediately adjoining the waterfront section involved were mainly of little value and in bad repair. As long as such structures are allowed to remain immediately adjoining a high value wholesale and manufacturing district, the conflagration hazard will be ever present.

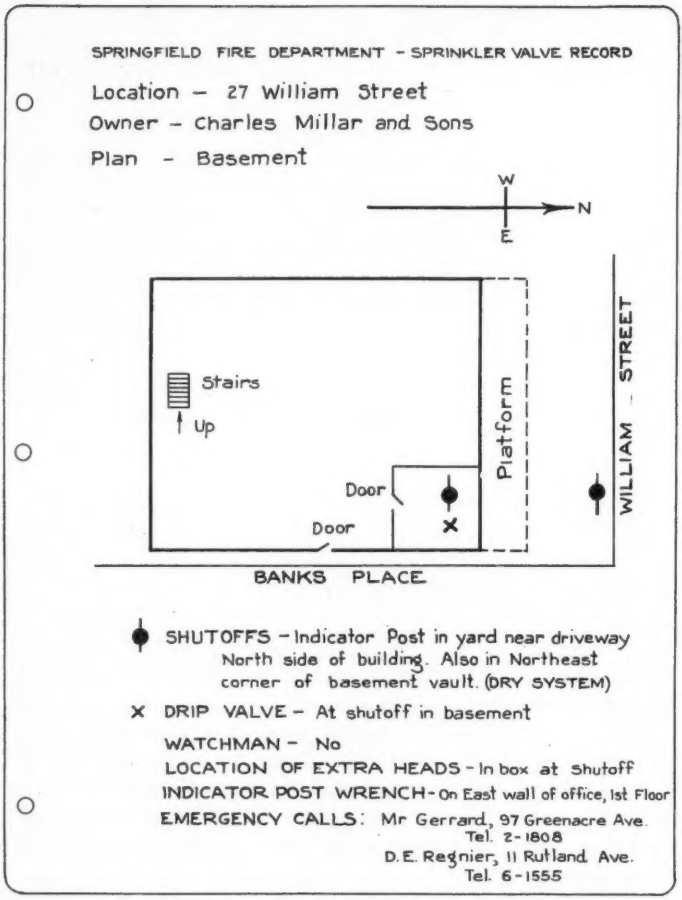
Although the storage of gasoline motorized equipments cannot be definitely established as the cause of this fire, indications point in that direction. It is extremely dangerous to permit the use of buildings of frame construction to be used for this purpose, and past experience has proven that these hazards cannot be overcome unless proper regulations and safeguards are provided.

The early report circulated that a fuel oil barge exploded is now believed without foundation. Neither the Port Authority nor any other public office could give any information as to the movements of such craft in the harbor. Information from the most reliable sources would indicate that it is not the practice to tie up such barges along the waterfront adjacent to high value districts.

The sprinklered properties in this district, especially the peanut factory, offered very little resistance to the fire; principally because no provision had been made for protection against serious exposure fires, construction was not of superior type, and the water supply was depleted by hose streams. In the case of the sprinklered building which was a total loss, the fire pump was not automatic in operation and not accessible on account of the intense heat. In the case of the other sprinklered building, the secondary source of supply was put out of commission in the early stages of the fire. Had these structures been equipped with adequate secondary sources of supply, no doubt the value of the sprinkler equipment in retarding the progress of the flames would have been increased. The large fire-resistive building mentioned in the previous section of this report formed an admirable fire barrier because adequate protection against serious exposure fires had been provided and the building not only served to check the progress of the flames in one direction but suffered very little damage.

From official estimate it is believed that about 3,600,000 gallons of water were pumped through the city mains on to the fire from the beginning of the fire until about midnight. This was in addition to the amount from nozzles and hose lines supplied by the fireboat *Vulcan* and the various harbor tugs which responded. The fire chief reported no shortage of water at any point in the burned area during the fire.

A very clear illustration is given of the fact that fire departments from various localities can respond and render material assistance. It is quite evident that the various organizations were welded together with great rapidity and functioned as one unit under the command of the Norfolk chief.


SPRINGFIELD FIRE DEPARTMENT - SPRINKLER VALVE RECORD
Location – 27 William Street
Owner – Charles Millar and Sons
Plan - Basement
W
N
E
Stairs
Up
Door
Door
Platform
WILLIAM STREET
BANKS PLACE
SHUTOFFS – Indicator Post in yard near driveway North side of building. Also in Northeast corner of basement vault. (DRY SYSTEM)
X DRIP VALVE – At shutoff in basement
WATCHMAN – No
LOCATION OF EXTRA HEADS - In box at Shutoff
INDICATOR POST WRENCH - On East wall of office, 1st Floor
EMERGENCY CALLS: Mr Gerrard, 97 Greenacre Ave. Tel. 2-1808
D.E. Regnier, 11 Rutland Ave. Tel. 6-1555

A Fire Department Sprinkler Valve Record.

Reproduction of a sprinkler valve record sheet in use by the Springfield, Massachusetts, Fire Department. A similar sheet is prepared for every sprinklered property in town. Enough copies of each sheet are made to furnish each district officer in the city with a complete file. Each sheet is kept to the size of an 8½ x 11 in. page, contains only the essential data shown, and is therefore in a form which has made it possible to bind the sheets in a loose-leaf binder, making a record which it is practical to carry to all fires.

The New National Board Building Code.

By Rudolph P. Miller,
(Member N.F.P.A.).

In arrangement, scope and substance the fifth edition of the Recommended Building Code of the National Board of Fire Underwriters, recently issued, is notably different from the previous editions. As the title page indicates, the Code has been "completely revised." Changes of practice in the building industry, new developments in building construction, as well as a now generally recognized principle that a building code should prescribe the purpose to be achieved rather than the methods of accomplishment, that is, that such code should not be a specification, made a thorough change not only desirable but necessary. Two years were devoted to its preparation under the general direction of the National Board's Committee on the Construction of Buildings. And let it be said that the committee's supervision was not a mere perfunctory discharge of its duties. Through the committee's efforts criticism from the technical personnel of the insurance interests throughout the country and, to a more limited extent perhaps, of the various building material interests, were solicited. Literally thousands of specific comments were received and individually considered during the work of preparation. The underlying thought is stated in the foreword: "In the preparation of this Code the principle has been followed that under the police power the requirements and restrictions relating to building construction should be stated in as broad terms as consistent with the attainment of public safety, public health and general welfare. It has, however, been necessary in certain matters included in the Code to be specific and detailed."

In its arrangement the Code follows generally, at least so far as the main topics are concerned, the recommendations of the Building Code Committee of the U. S. Department of Commerce, of which the late Ira H. Woolson, who was closely identified with the earlier editions of the National Board Code, was chairman. That arrangement was the subject of much discussion and was offered only after consideration of several other arrangements that had been suggested, and of criticisms that had been submitted concerning it.

The use of the term "article" for the main divisions of the Code, instead of "chapter" as used by the Department of Commerce Committee, conforms with a practice followed by municipalities in making their building code a

This article by Mr. Miller, who acted in a consulting capacity in the preparation of the 1931 edition of the recommended building code of the National Board of Fire Underwriters, gives a general review of the new edition, discusses the underlying principles that have been followed, and the important differences between this and the previous edition. —Ed.

part, that is a chapter, of their code of ordinances. The article deals with a general, broad subject. The significant division is the section, which deals with some outstanding subject, indicated by its title. It will be noted that the numbering of the sections is continuous throughout the Code; that is, it does not start anew in each article. It may also be observed that the section number is indicative of the article of which it forms a part. The lapses in numbering between the last section of one article and the first of the next article, permit the insertion of new sections when necessary to meet some new development, without disturbing the existing numbering, thus avoiding possible confusion in cross-reference and changes in the index. Whenever desirable, a section is divided into subdivisions, these being also numbered but with the numbering starting anew in each section. For convenience each subdivision is given a title. When the context of a subdivision becomes lengthy, it is further divided into lettered paragraphs. It is believed that subdivision of the text has been carried far enough to afford the convenience in use for which it is intended. References in the index are by section number, supplemented, as need be, by subdivision and paragraph.

In the foreword of the fourth edition (1922) reference was made to three features as new. One was "the use of numerous notes scattered through the text, serving either as recommendations, cautions, or explanations." This feature has been retained in this new edition with the same object in view, namely "to make the Code a guide or textbook for commissions engaged in drafting ordinances." It is believed that it will also serve to give the building official a better understanding of the principles underlying the several requirements. Illustrations, which were mentioned as the second feature of the fourth edition, have been greatly reduced in this edition. Some of them have lost their pertinence and others seem superfluous. The use of cross-references, the third feature of the fourth edition, is continued in this edition. The much enlarged appendix of the new edition (fifth) might perhaps be considered a special feature.

The scope of the Code, as described in the foreword, is intended to cover "all matters relating to the construction, alteration, removal or demolition of buildings or structures; and so much of the equipment, occupancy and maintenance as must be considered in the planning; and so much of the equipment as must be installed as the building operation progresses." It is hoped and urgently recommended that this Code be supplemented by the adoption of the recently revised "Suggested Fire Prevention Ordinance," which would regulate the use and occupancy, and equipment of buildings so far as they are not covered by the requirements for planning. It is recognized that changes of occupancy are not unusual, but the use and occupancy of buildings and structures for purposes for which they are not suited, either by reason of construction or lack of equipment, would be prohibited. In adapting existing buildings

to new uses, such new construction or changes in permanent equipment as may be necessary must conform to the requirements prescribed for new buildings. The pernicious practice, found in some localities, of placing a premium on old, obsolete buildings by permitting their use for other purposes than those for which they were planned, on the assumption that the change is only a temporary one, is not sanctioned; though existing uses which had once been lawfully established are not to be disturbed, so long as conditions which are not detrimental to life or health are maintained. It is assumed that buildings which have been in use for some time past for a given purpose complied with such statutory requirements as applied thereto at the time of its establishment. Ample authority is delegated to the building official to correct or abate unsafe conditions that may develop either in existing or new buildings, as to structural safety (§106), to inadequacy of exits (§ 600), or to hazards from improper installation or protection of heat appliances (§ 1201-5).

To secure the benefits of a building code in any community, there must be a fair, honest, unbiased administration. The official must have a good general knowledge of current and acceptable practice in building construction. That he may be free from political or other baneful influences, his tenure of office should be secure during good behavior. If properly qualified, his judgment may be trusted to administer the Code in the interest of the public, to secure its general intent without too literal an interpretation. If he is not properly qualified, the specific requirements of the Code will have little meaning to him, nor will they be any guide to him in the conduct of his office.

It has been already intimated that the Code is not intended as a specification. The standards of quality of building materials are at present so well established and so generally recognized that the incorporation of detailed specifications would merely increase the bulk of the text to no special advantage. So too, standards of construction practice have been set up which are available to the qualified official. He should appropriate them to his own use as rules *to carry into effect* the provisions of the Code. So long as he utilizes them merely to supplement the Code and does not attempt, through the authority delegated to him, to alter or extend the statutory provisions, there is little doubt that they will be as effective as the law itself.

The rule-making power which the Code delegates, with certain limitations, to the building official is of even greater importance in so far as it applies to new materials and methods of construction. It is manifestly impossible to anticipate new developments in the building industry. Unless there is some provision to make these new developments available when their sufficiency and practicability have been established, the public is deprived of such benefits as they may afford, or of economies that might possibly be effected, an injustice to both the public and the originator. A properly qualified official is a much better judge of their admissibility than the local legislature which would

otherwise be the medium through which acceptance would come in the form of amendment to the Code, a procedure that is likely to have a political tinge, if it is not a mere perfunctory action on the recommendation of the building official.

It is important to a clear understanding of many of the provisions that the specific meaning of certain terms shall be known. In order that there may be no excuse of misinterpretation, resort has been made to the device of attaching an asterisk to each term which has been defined to call attention to that fact. To define a term is to limit its meaning and restrict its application. When that is not strictly necessary it is better not to define, but to let the ordinarily accepted meaning appertain. There are two reasons for the definitions in this Code, namely, to strictly limit the application of the term, and to avoid the repetition of qualifying words or phrases. The first reason holds for every definition. The second applies in the case of such a word as "dwelling," which, according to the dictionary, has the same meaning as "residence" and "home." In this Code it is made to apply to a particular type of residence, and is defined so that it will not be necessary to repeat each time the qualifying words of the definition. The term "bulkhead" as used in the Code has been the object of some criticism. It was contended that the use of the word should be properly limited to either the partitions which form separate compartments in a ship, or to the water face of a wharf or sea wall. Yet the Dictionary of Architecture and Building (Sturgis) gives the word the same meaning as used in this Code. It is used in many building codes in the same way. It has been so used in the laws of New York since 1887. In the fourth edition it was used synonymously with "penthouse," though in the new edition it is distinguished from that term. The word "concrete" is a well-understood term, hardly requiring definition, but when used in the Code with the asterisk attached, it is restricted to concrete of a given mixture; again, because of frequent use, merely to avoid repetition.

Classification according to occupancy is nothing more than listing the five divisions which have been made for convenience in fixing appropriate requirements. It will be noted that the division applies only to buildings; that is, it does not include those structures which are not "adapted to permanent or continuous occupancy of residence, business, assembly or storage purposes." As the term building is to be construed as if followed by the words "or part thereof," the classification of occupancy may apply also to only a part of a building. It is quite a common occurrence to have a building occupied in two or more ways; stores are frequently located in residence buildings; places of assembly are not unusual in mercantile establishments or in office buildings. When such mixed occupancies occur the provisions of the Code applying to the various occupancies must be enforced in those parts of buildings that may fall within the class. If there should be conflicting provisions, those securing

the greater safety shall apply. The five classes: public buildings, institutional buildings, residence buildings, business buildings and storage buildings are defined in the article devoted to definitions. The classes used in the Code coincide in number and description with those adopted by the Department of Commerce Building Code Committee. Compared with the classification used in the fourth edition of the National Board Code, some marked differences will be found.

Relating to construction, six types are recognized, corresponding in number and kind, though not in name, to those of the Department of Commerce Building Code Committee recommendations. In the classification of construction there is a fairly close resemblance to the earlier edition of the National Board Code. A modified type of fire-resistive construction, less drastic in its requirements than those that have heretofore been prescribed, for use in buildings having a moderate fire hazard due to occupancy, is created and designated "semifireproof construction." The two divisions of the former "non-fireproof" class are retained but given full class status; the designation "mill construction" is changed to "heavy timber construction." The class known as "frame construction" is retained, but segregated into another class; "unprotected metal construction" is the type, commonly known as metal-clad, used extensively for industrial buildings.

While there are advocates of so-called zoning restrictions who believe that provisions included under that head should properly be included in the building code, the policy of enacting separate ordinances dealing with this matter is practically universal. It was thought best, therefore, not to elaborate this topic in the Code, but confine a reference to zoning restrictions to a general recognition, as controlling, of those provisions which do not impair the Code provisions applying to construction.

A form of zoning which antedates the present governmental regulations that fall within that appellation and which in most communities of this country constituted the earliest form of building regulations, namely, the establishment of fire limits, is retained. The policy to be applied in fixing the boundaries is the same as advocated in the past by the fire prevention interests. It is not incorporated in the text of the Code, but is given in an explanatory note. Within these restricted areas all new buildings shall have exterior walls of masonry, and alterations of and changes of occupancy in existing buildings shall be so limited that frame construction and unprotected metal construction shall gradually disappear. Certain exceptions that have been quite generally recognized as reasonable are enumerated.

In fixing the limitations for the several types of construction, the controlling considerations are, aside from the matter of fire limits, the intended occupancy of the building and its size. For certain occupancies, namely, asylums, detention buildings, hospitals, jails, and nurseries, because the free-

dom of the occupants is quite generally restrained, the type of construction offering the greatest protection against fire, that is "fireproof" construction, is required, irrespective of size or location. Theatres also are included in this group. This type of construction is also required for all new buildings that exceed ten thousand square feet in area or seventy-five feet in height, provided that when the occupancy places the building in the storage building class, the limit of height for other than fire-resistive construction is fifty feet. Except for garages, which are limited to ten thousand square feet in area, no limitation of size has been set for fireproof construction. The recommendation of the earlier edition to fix a maximum height limit on factories, stores and warehouses at eighty-five feet, and on all other buildings at one hundred and twenty-five feet has proved futile and, in the light of present experience, is unnecessary. The same statement seems justified regarding maximum areas so far as fire-resistive construction is concerned.

As previously intimated, a new type of construction, designated "semi-fireproof construction," is recognized. Even though, as a careful study of the Code will reveal, the minimum requirements for "fireproof construction" of the fourth edition have been somewhat lessened, the essential difference being that for floors and roofs under the new Code (fifth edition) a fire resistance of three hours is acceptable as against four hours previously required, it would be still an unnecessarily severe requirement from the fire protection standpoint and hence economically untenable, to demand "fireproof construction" in buildings occupied as residences, hotels, schools, hospitals, asylums and even ordinary business offices, in which the combustible contents cannot be said to constitute a serious fire hazard. While admitting this lesser hazard for the occupancies mentioned in comparatively low buildings, the hazard, however, undoubtedly becomes more serious as the building increases in height, inasmuch as the difficulties of controlling fire become greater with increase in height. For this reason this type of construction has been limited to seventy-five feet in height, the point above which few municipal fire departments are equipped to subdue a fire from the street. A further consideration in fixing the height limit for this type of construction is the need for greater rigidity in the construction of the building as it reaches greater heights. Several types of floor construction that would be acceptable under the two-hour fire resistance specified for semi-fireproof construction do not require, nor do they contemplate, a rigid attachment to the structural frame. Though that frame may be designed fully to resist lateral forces to which the structure is subjected, it is the floor construction that must be depended upon to resist torsional stresses. Only in business and storage buildings (offices, stores, factories, warehouses, garages) is there an area limitation of ten thousand square feet, except that garages are limited to seventy-five hundred square feet.

Respecting other types of construction, the area limitations remain as

specified in the fourth edition. The same permissible increases in area, on account of accessibility, that is, when facing on two or more streets, are allowed. Great credit for sprinkler equipments is given. Under the new Code a general hundred per cent increase is allowed, two hundred per cent for one-story buildings, as against a sixty-six and two-thirds per cent increase under the fourth edition. Outside the fire limits further increases in public, business and storage buildings, not exceeding two stories in height, are permitted in the discretion of the chief officer of the municipality, the building official and the fire chief acting as a board. In the height limitations, without attempting to give the specific changes, generally there has been a liberalization in the residence building class, practically no change in business buildings, and an abridgment for other occupancies.

It is difficult to provide in a building code for all contingencies that may arise. It is desirable, therefore, to leave to special action by the local legislative body the fixing of desirable or necessary restrictions against the establishment of occupancies that may, by reason of noise, fumes, disagreeable odors, danger of fire or explosion, be or become public nuisances. In fact a code cannot take from that body the authority it has to legislate in such matters. As an indication of what reservations are intended, occupancies that must have such special permission are listed.

The lighting and ventilation of buildings is not always regulated in the building code, but sometimes is the subject of separate legislation. Too frequently, however, the laws or ordinances deal with the matter, in great detail, for multifamily houses only. With increasing congestion in our municipalities attention should be paid in this respect to all classes of occupancy. The health of the community when engaged in its daily activities is as important as when resting at home. The essential provisions are embodied in one article of the Code. They provide for two general methods of securing proper conditions, either by direct, natural ventilation to the outer air or by mechanical means. For rooms, called habitable rooms, in which persons live, eat or sleep as a part of their home life, or in temporary abodes away from their homes, natural ventilation is required. For places where persons work or pursue their usual daytime occupations, the necessary air must be secured either by natural ventilation or by mechanical means. When persons congregate in numbers for educational, religious, social or recreational purposes, positive ventilation by mechanical means is prescribed. In buildings where persons are detained, more or less involuntarily, as in hospitals, a choice of either natural or mechanical ventilation is demanded, with the addition that natural light must be supplied. When, for rooms that require natural ventilation, the requirements for the size of such rooms, the amount of window space and the extent to which it shall be available for permitting the admission of air and the minimum open, unoccupied and unobstructed permanent open space on which

the window opens, are prescribed, it would seem that the required healthful conditions have been fulfilled. So far as the necessary open spaces are concerned it makes no difference whether they are streets (in the broad sense of public spaces as defined in the Code) or courts, which in given circumstances may be known as yards, so long as these spaces remain of the prescribed dimensions, open and unobstructed during the existence of the rooms served by them. What relation the dimensions of these open spaces should bear to the height of the building and the position of the rooms must necessarily be prescribed in the Code. When mechanical ventilation is permitted or required, it must be designed to supply adequate changes of air, properly conditioned, to maintain a healthful status. The latest recommendations of the American Society of Heating and Ventilation Engineers are accepted as a safe guide.

For the safety of the occupants of buildings ample exit facilities are required. As no standards that have met with general approval have yet been developed, although much earnest study has been given this subject, it is necessary that the provisions of the Code should be detailed and specific. The practice and experience in New York City, which, according to latest reports has thus far been found safe and satisfactory, would seem to serve as a good basis, and has been followed in the Code. In general it provides for exit facilities so planned that the occupants may either leave the building en masse in a comparatively short time, as generally occurs in low buildings and in places of assembly, or that, in taller buildings from which rapid egress is a practical impossibility, they may find a place of refuge of sufficient area to accommodate them from which they can leisurely find their way to the exterior of the building. Under the second method either the stairways through the upper stories must be of adequate dimensions to hold the occupants who would resort to them, or the building must be divided into accessible sections to which resort may be had from one to the other, with facilities for getting away at leisure. In either case protection against the actuating trouble must be afforded the occupants in their places of refuge by walls or partitions of substantial fire-resistive construction and protected openings. For determining the spaces to be provided the number of occupants must be known or assumed. The applicant for the permit for the building should be free to specify the number of persons for whom exits will be provided. As he may not avail himself of this privilege, a basis for the assumptions to be made according to the class of occupancy must be prescribed. Except where the areas of any story are so small that only one exit stairway is practicable, at least two means of egress are demanded. When conditions admit of only one, that one should be thoroughly dependable; it should be in fact a fire tower. When floor areas become extended, the number of exits must be so increased and located that it is not necessary to travel a great distance to reach one. This Code does not recognize the ordinary outside iron fire escape, so called, as a safe or suitable

means of egress from a new building. As a makeshift for existing buildings which need additional facilities, it may be condoned in case other really suitable means of egress are not possible. Well-constructed and properly proportioned outside stairways need not be prohibited. The provisions of this Code relating to exits are not intended to be retroactive, but existing buildings, by reason of changes since their erection, are not always safe. The building official must have discretionary powers to direct such alterations as may be necessary for the safety of the occupants.

The brevity of the provisions relating to the quality of materials may, perhaps, seem strange. But is it not sufficient to indicate that the materials of construction used in the erection of buildings shall meet the intent of the Code? Such materials when used must produce the results prescribed. Assuming that the required characteristics of some materials are given in full, the building official must still be the judge of whether the product of a particular manufacturer meets those characteristics and that its application results in safe construction. If there is a prescribed standard he may not depart from it, no matter what economy or other benefit may be derived from some deviation from that standard. If he is free to use a generally accepted standard, he is quite as sure of satisfactory results as if he had a standard set for him. If there is any reason to distrust a current trade standard, he should, and under the Code, would have authority to set up a proper standard, provided he observes the prescribed procedure. For the materials in general use, good safe standards, universally accepted, have been prepared by competent committees. In the appendix the regulations of the National Board and several scores of standards promulgated by the American Society for Testing Materials are listed. For new materials, if the public is not to be deprived of the benefits they may bring, the building official must, in any event, set up a standard, or else resort to the slow process of amendment of the Code, with possible political complications and certainly no better conclusion.

Regarding working stresses, there are those who hold that they have no place in a building code; that they are purely matters of design and should be left to the designer's judgment. This view might be tenable if the responsibility of the designer for safe construction were well established. But, unfortunately, the percentage of those who plan and construct buildings in this day, whose competency, or, in many cases, honesty, is to be trusted, is exceedingly small. Fully nine-tenths of the building operations (in numbers, not value) in this country are in the hands of designers and operators who must be directed. Hence it is in the public interest to prescribe in the Code suitable working stresses, at least for the materials in general use.

The working stresses that are prescribed in the Code are admittedly conservative. They are such as are appropriate for materials commonly available, for they are the materials used in that same ninety per cent of building opera-

tions just referred to. That there may be no discrimination against better grades of materials, provision is made that, on the filing of satisfactory evidence that such material will be used, the building official may allow correspondingly higher working stresses, provided he is satisfied that the applicant is thoroughly competent and fully responsible. In such cases the official, too, having been put on notice, must see that the conditions under which the concession was granted, are complied with. In the ordinary case he is relieved of that obligation. There is not an official inspection bureau in the country that is equipped to check the grade of materials used in every building operation. As a guide to the building official of allowances that may be made in the matter of working stresses, information is given in several appendices.

In building construction, proper workmanship is probably the most important element contributing to safety. Wide discretion must be left to the building official, for no matter how elaborate and detailed the provisions of the Code may be, he must be the judge of the result. Here again reliance can be placed on established trade practices and standards. These are not intended to be mandatory, but in the absence of specific requirements of the Code or duly promulgated rules, such standards shall be deemed to represent the generally accepted good practice which must be the official's guide. Certain details fixing minimum requirements are necessarily incorporated in the Code which serve as the basis for such rules as he may find desirable to carry into effect the purposes of the Code.

In fixing the minimum thicknesses of masonry walls it is important to keep in mind several influences that affect their stability. It is not sufficient to consider merely their strength, that is, their ability to support the loads that may be imposed. Fire resistance is quite as important a consideration. Too much reliance must not be placed on tests conducted on samples of necessarily limited dimensions. Such tests are of undoubted value for comparison of results. They furnish useful information concerning resistance to dangerous heat transmission. But they cannot serve as the only criteria in judging walls of several stories height. Here the experience in actual fires must be drawn upon. In the interest of the safety of neighboring property, a wall must be of sufficient bulk to resist dangerous distortion. The probability of such distortion is, no doubt, less in the case of buildings of lower occupancy hazards, such as residence buildings, as compared with mercantile establishments. When the interior is of combustible construction, the likelihood of dangerous distortion is greater than when fire-resistive construction has been employed. As not so much is dependent on a non-bearing wall as on a bearing wall, it is, perhaps, reasonable to permit less thickness in the former. More than in any other case is stability needed in a fire wall or party wall.

Every building code, unless there are other statutes that fully cover the

matter, should provide for safeguards during construction. Three interested parties are involved: the workers who are employed on the building operation, the public whose interest or ordinary daily activities may bring them in contact with the work, and the neighboring owners whose lives or property may be endangered by falling objects or by fires that may originate in the course of operations.

Recent years have witnessed much research, the results of which have had a marked influence on policy and practice in fire-resistive construction. In the fourth edition of the Code, the earlier policy of specifying definitely the methods to be used in protecting the structural elements of buildings was followed. The practice of that day was based on individual tests and methods that had been previously assumed to be effective. Today performance under the standard fire test is the criterion of acceptance. Any form of construction that affords the prescribed fire resistance shall be admitted to use. Forms of construction that have stood the test of time and experience, though they may not have been the subject of a fire test, are not to be excluded. These as well as some others in general use are enumerated as a convenience to officials whose facilities for keeping informed on the latest developments are limited, and, incidentally, to designers who lack the ambition to keep abreast of building progress. Certain minimum requirements, dictated by prudence, are fixed; thus a minimum thickness of two inches for column protection is specified. In fireproof construction all members of steel skeleton structures must be individually protected. In general the requirements for "fireproof" and "semi-fireproof construction" are similar, the difference between them being in the minimum required time-classification periods specified for structural members as follows:

	"Fireproof Construction"	"Semi-fireproof Construction"
Fire and party walls	4-hour	4-hour
Bearing walls	"	3-hour
Other walls	3-hour	"
Isolated piers	4-hour	"
Columns	"	"
Wall-supporting girders	"	"
Other girders	3-hour	2-hour
Beams	"	"
Floors	"	"
Roofs	"	"
Floor fillings	"	"
Fire partitions	2-hour	"

With respect to roofings the new edition is substantially in agreement with the fourth edition. Class A or B roofings under the test specifications of Underwriters' Laboratories, Inc., are declared acceptable for all buildings, irrespective of location. Class C roofings are acceptable for, but limited to, dwellings and frame buildings wherever located, and, outside the fire limits,

buildings which do not exceed two stories or thirty feet in height nor twenty-five hundred square feet in area and are not occupied as mercantile establishments, factories or warehouses. Repairs to existing roofings that do not conform to the preceding requirements are limited to one-tenth of the roof surface. The complete elimination of wooden shingles or combustible roofing within the fire limits within a period to be set by the local legislature, is contemplated; though this requirement is not to require the removal of such roofing, if it is covered over with new conforming roofing. Recognizing the fact that some municipalities are not in sympathy with the entire elimination of wooden shingles, a suggestion of the restrictions that should nevertheless be placed on their use, is embodied in an appendix to the Code.

Provisions regulating the construction of chimneys, flues, fireplaces and vents, and the installation of heat appliances and forced draft systems follow quite generally the practice laid down in the fourth edition and in the regulations of the National Board.

The new edition, in dealing with theatres and other places of assembly, does not retain the differentiation of the fourth edition between theatres, moving picture theatres with less than 300 capacity, and assembly halls and other amusement halls. Definite distinction between these occupancies is impracticable. Exit facilities are necessary to the same extent in all of them, according to the number of persons to be accommodated. The necessary provisions for these should be, and have been made in the article devoted to means of egress. Differences in hazards in these occupancies are due to the introduction of a stage for theatrical performances or the use of a picture projection machine. When a stage is introduced, the necessary safeguards to meet the additional hazards should be prescribed, and they are as important whether the hall is used as a public theatre, or is the assembly hall of a private club, or the auditorium of a school. The hazards are the same in all cases. Again, the safe arrangement of seatings and aisles is equally essential in the several halls. The picture projection machine being movable equipment, the provisions regulating its use are incorporated in the National Board's Fire Prevention Ordinance.

Standpipes, automatic sprinklers, electric wiring, elevators, plumbing, gas-piping, and signs constitute topics over which official control is provided in the last five articles. When these matters are regulated in other laws or ordinances the articles dealing with them would, as a matter of course, be omitted from the Code when adopted, as expected, by municipalities generally.

Buffalo Armory Fire.

The conflagration menace of flying brands and wooden shingle roofs was again brought out in a fire that completely destroyed the 106th Field Artillery Armory at Buffalo, N. Y., on the evening of May 6, 1931. The loss to the Armory and its contents has been estimated at approximately $7,000,000, while flying brands were responsible for the destruction of a frame church and more than seventy-five roof fires, causing an aggregate secondary loss estimated at more than $32,000. Some fifty automobiles were also ignited and damaged.

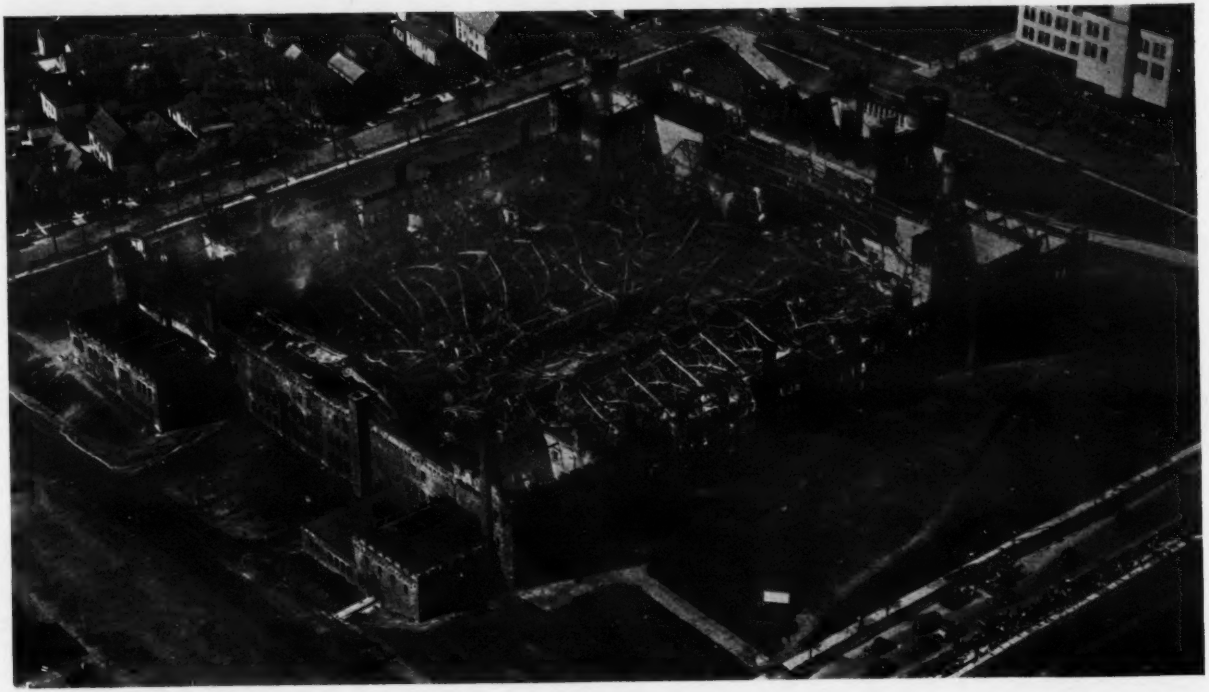
Property Involved.

The Armory in which the fire had its origin is said to have been one of the largest in the country if not in the world. It was located at the top of a small hill in a closely built residential section at Masten, Best and North Streets, and occupied an entire city block. An open space of at least 150 feet separated the Armory from any other buildings in all directions. Across the street from the north side of the Armory is a large reservoir covering an area of approximately fifteen acres. The direction of the wind was such that burning brands from the Armory were carried across one end of this reservoir and showered the roofs of the residential district beyond. The fact that a large proportion of the burning brands fell harmlessly into the reservoir probably prevented a widespread conflagration.

The Armory was built in the period from 1902 to 1907. It was 410 feet long and 325 feet wide and covered an area of approximately 150,000 square feet (more than three acres). For the most part it was three stories in height. An unusually large drill shed took up most of the area above the basement, this section being open to the roof. Around the drill shed on three sides of the building was a series of rooms for the use of the various organizations using the Armory.

The exterior walls were of heavy masonry construction. All windows and doors to the basement and first floor were barred with steel grilles. The floor over the basement was of wood on heavy wood joists closely spaced and supported on unprotected steel girders on hollow cast iron columns. The rooms on the upper floors were reached by stairs leading to a balcony at the second floor level. This balcony projected partly over the drill floor and was supported by steel columns encased in ornamental hollow wooden posts. The stairs, partitions and balcony floors were principally of wood with some metal

This report has been prepared from the report issued by the National Board of Fire Underwriters under date of June 8, 1931, supplemented by a personal inspection made by N.F.P.A. engineers, and information supplied by local authorities.



Buffalo Times.

General view of Buffalo Armory, showing size of the building and the complete destruction of its interior and contents in the fire of May 6, 1931, involving a loss estimated at $7,000,000.

lath and plaster ceiling under the balcony. The wooden roof over the drill shed was supported by arched steel trusses of unusual length, entirely unprotected. Skylights were of ordinary glass.

Exit facilities were very poor, there being but one readily accessible exit from the main floor at the front. A company of men who were using the drill floor when the fire was discovered and a group of women, members of Troop 1 Post Auxiliary who were playing cards in an adjacent room, were forced to make a rapid escape from this one main exit to avoid being trapped. Several doors to the basement were said to have been locked when the fire started.

Access to basement sections from the outside was by way of single doors on the east end of the building. Due to the slope of the land, the grades are somewhat higher at the west end, and the only other means of entering the basement was by way of the main entrance door at the drill floor level and thence through two stairways, difficult of access, at the front and at the rear.

The other building seriously involved in this fire was the American Scandinavian M. E. church, situated at the corner of Masten and Northampton Streets, nearly a third of a mile north of the Armory. The roof of this 2½-story frame structure was ignited by flying brands, and before apparatus could be dispatched from distant stations the entire building was ablaze.

In addition to these structures a considerable number of roof fires were started by flying brands. These roof fires for the most part occurred in the four blocks just beyond the reservoir to the north of the Armory, although two of them were over a mile distant. This is a closely built residential section composed mainly of two-story frame dwellings eight to ten feet apart, about eighty per cent of which have wooden shingle roofs. The accompanying map indicates the location of the roofs damaged.

Protection Against Fire.

The Armory was equipped with standpipes to which hand hose was connected. It is said that a futile attempt was made to use this hose before the arrival of the fire department. Although the engineer of the building is said to have remained on duty in the boiler room during the entire period of the fire, it is stated that the fire pump was not operated. The fire was apparently beyond the control of first aid devices when discovered.

Story of the Fire.

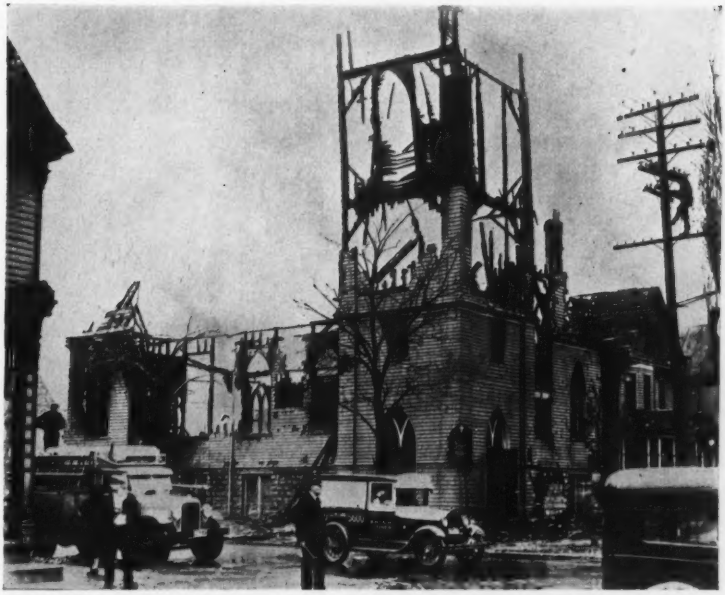
The fire was discovered shortly before ten o'clock. Two American Legion drill teams were on the drill floor when one of the men, a member of the Buffalo Fire Department, observed smoke curling up from a corner of the floor. He ran to the corner, placed his hand over the crack, and found considerable heat seeping through. The drill was immediately abandoned and members of the drill teams assisted women spectators and women members of the Post Auxiliary, who were playing cards in one of the rooms, to make their escape through the main entrance.

Buffalo Times.

The main entrance of the Buffalo Armory at the height of the fire. Lack of fire-stopping presumably permitted the fire in the basement to spread to upper sections of the building. Note steel grille work at windows, which hampered firemen in effectively placing their hose streams.

The first alarm was received at 9:50 P.M. from box 1419, located at the high school, directly opposite the main entrance of the Armory. When the fire department arrived the southwest section of the basement appeared to be involved. Entrance was made through an outside door at the east end of the building, but considerable difficulty was experienced in getting at the seat of the fire because of the dense smoke and the distance of the blaze from the basement entrance. Holes were cut through the main floor in the drill shed for the use of cellar pipes and distributing nozzles but, while the fire was somewhat retarded for a time by their use, these appliances proved ineffective because of the tremendous area of the basement involved. Dense smoke filled the building and, combined with the fumes of burning varnish, with which the floors were heavily coated, seriously hampered the firemen, rendered their smoke masks ineffective and eventually drove the men from the building. A considerable number of them (seventy) suffered materially from the effects of the smoke, and some were rendered unconscious.

In the meantime second, third and fourth alarms were sounded at 10:15, 10:32 and 10:58 P.M. These alarms were followed by telephone calls for other companies until practically the entire department, consisting of thirty-six engine, fifteen ladder and three squad companies were in service. At the height of the fire the apparatus available for additional alarms consisted of



International.

The American Scandinavian M. E. church and parsonage, Buffalo, N. Y., severely damaged by a fire started by flying brands from the Armory fire, which landed on the wooden shingle roofs.

but two engines, one ladder truck, one high pressure hose wagon, a water tower and a fireboat.

The off-shift of the department was not called, and it is said that no outside aid was officially summoned, although press reports indicate that at least one outside company responded.

The fire spread gradually to the upper or mezzanine floors and to the roof, indicating the absence of adequate fire-stopping in partitions and proper protection for vertical openings. The flames broke through the roof at 11:45 P.M., and at 12:05 A.M., after all firemen had been ordered from the building, the roof collapsed.

During the hour preceding midnight a gentle breeze had been steadily freshening, and at the time the roof caved in a stiff wind was blowing. The shower of sparks sent skyward by the roof collapse were carried over the reservoir to the residential section to the north and northwest, starting innumerable roof fires. The first house suffering damage, as far as can be learned, was at 234 Masten Street, about six blocks from the Armory.

Soon the roof of the American Scandinavian M. E. church at Masten and Northampton Streets was discovered to be on fire. Before apparatus could arrive from distant quarters or be sent from the main fire four blocks

Buffalo Evening News.

The closely built residential section of Buffalo north of the Armory, showing some of the roofs damaged by flying brands. The church, which was severely damaged, appears in the center of the picture.

away, the entire upper portion of the structure was ablaze. Within an hour the building was virtually destroyed, and the frame parsonage, together with another adjacent building, was badly damaged. Other roofs in the district caught fire, but were extinguished with minimum losses by companies responding to calls for assistance and by firemen detailed from the main fire, assisted by house owners and citizens.

Men and boys climbed to the roofs of the dwellings in the district, armed with brooms and pails to extinguish the sparks landing on the roofs. Streams from garden hose were used to wet down the roofs and extinguish burning embers as they landed. The rapid maneuvers of fire apparatus and the efforts of these volunteers undoubtedly prevented a serious conflagration in this residential district. Apparatus dispatched by fire alarm headquarters responded to six box alarms and numerous telephone requests for assistance in this area.

As nearly as can be ascertained, there were eighty-two instances of ignition in addition to the Armory, excluding approximately fifty automobiles that suffered more or less damage. There are said to have been 79 roof fires, two awnings and one carpet. Two of the roofs involved were ignited three times and seven of them twice. This makes seventy-one locations of fires besides the Armory, exclusive of automobiles. All of the roofs involved had wooden shingles except two, which were old tar and gravel.

Commissioner Hedden, in charge of the Buffalo Fire Department, commented in a local paper on what might have occurred had another fire started while virtually the entire department was engaged at the Armory fire or chasing roof fires along Masten and adjacent streets. He said in part:

I don't like to think what might have happened if we had had a downtown fire just at that time. There would have been no companies to fight it. The two pumpers in service would have been wholly inadequate.

I would have had to call on cities and villages near Buffalo for help, and much of that would have been slow in arriving. Just where such a fire might stop, there is no telling.

Buffalo is a city of shingle roofs. Any fire of major proportions that got out of hand might carry through several miles of the city; the shingle roofs would see to that.

The Armory fire might have produced just such a situation, but fortunately the wind was not of sufficient force to carry the sparks and the embers over a large area. Just that saved Buffalo from a conflagration last week.

In describing the fire, W. R. Castimore, Deputy Commissioner of Fire, said:

One's attention is again called to the danger of indiscriminate frame construction with wood shingled roofs. Had a strong wind been blowing instead of a mere breeze, Buffalo would probably have had a major conflagration. As it was, a church and several homes were badly damaged when ignited by flying embers in spite of the fact that the whole block immediately north of the Armory is occupied by the Prospect Reservoir.

Little was left of the Armory except the four walls, which remained standing. The roof trusses were a twisted mass of steel, and of the wooden roof and interior floors and partitions scarcely a vestige remained. The heat was so intense that the steel frames of trucks and tractors stored in the basement were warped and distorted.

A continual stream of water from several lines of hose saved the powder and ammunition magazine. Constructed of concrete, the magazine withstood the intense heat, the only damage being a crack in the outer surface. Likewise the paint storeroom adjacent to the magazine, in which gasoline and turpentine were stored, was not damaged.

Automobiles, coming to the scene of the fire following radio broadcasts describing its progress, hampered the fire department seriously, in spite of the efforts of the police to regulate the traffic.

Cause of the Fire.

The Board of Inquiry appointed to investigate the fire, in its report to Governor Franklin D. Roosevelt, found three possible causes of the fire, although the exact cause has not been definitely determined. The theory of incendiarism was discarded.

The first possible cause was the careless disposition of a cigarette or match. Evidence was produced indicating that in the past several minor fires had occurred, caused by a cigarette being dropped into the ventilating flues leading to the basement or by a cigarette carelessly thrown under the baseboards. It is possible that the cause of this fire was due to a cigarette care-

Buffalo Times.

A corner of the basement after the fire, showing complete destruction of combustible material, and wreckage of steel work.

lessly thrown in or among canvas or oily waste in the basement, or under the baseboards on the main drill floor, where it might have ignited rubbish or sweepings in or about the partitions, burning along the floor of the drill hall and joists over the basement.

The second possible cause was a defect in the electric wiring system (which was about 24 years old), causing a short-circuit which caused the circuit breaker in the engine room to open, and the engineer's act in blocking this breaker to maintain lights in the building. According to the testimony of the engineer the circuit breaker opened at 9:50 P.M. and he blocked it open with some blocks of wood in order to prevent a possible panic should the lights of the building be extinguished with people on the main drill floor. If the circuit breaker actually opened at 9:50 P.M. it was simultaneous with the sounding of the first alarm of fire, and it would appear that the fire had at that time burned through a conduit, causing a short circuit which threw out the breaker. If, on the other hand, the engineer was mistaken as to the time when this circuit breaker opened, and it actually was at 9:30 P.M., the blocked circuit breaker might have been responsible for the fire.

The third possible cause was defective wiring on a motor truck or an overheated motor truck in the south basement.

Losses.

The preliminary estimates of the total loss to the Armory were set at $7,000,000, which may be high. However, it seems probable that the loss will

be at least $4,000,000. The preliminary figures were based on the following items:

Equipment and supplies	$4,000,000
Building	3,000,000
Total	$7,000,000

The only equipment saved from the fire was a single truck loaded with small calibre ammunition in case lots, which was driven from the basement by Armory employees at the start of the fire. The building and equipment were not covered by insurance.

To this total loss at the Armory itself must be added the substantial losses in the neighborhood, the church on Masten Street, and the numerous roof blazes occasioning a loss of more than $30,000, partly insured.

Conclusions.

The lessons of this fire are obvious. The large loss to the Armory again points out the danger of unprotected steel members and combustible interior construction in buildings of this size housing valuable contents. Slow-burning or fire-resistive construction would have retarded the spread of the flames, and with adequate entrance facilities the fire department might conceivably have controlled the fire with a minimum loss to the building itself. Automatic sprinklers would probably have extinguished this fire in its incipient stage or at least held it in check until the arrival of the fire department.

The hazard of flying brands was clearly apparent to the fire department and others, as is indicated by the statement of the engineers of the National Board of Fire Underwriters which appeared in their report of the city made in 1927, as follows: "Wooden shingle-roofed frame dwellings present the usual hazard of flying brand fires which, due to congestion and the high winds, is augmented to a very pronounced degree."

The use of a large proportion of the available companies and apparatus at a single fire in a large city is detrimental to the protection of other sections of the city. Provision for the use of reserve equipment manned by members of the off-shift to replace companies on duty and the assignment of other members of the off-shift at the fire to relieve companies responding on multiple alarms would overcome the conflagration possibilities entailed by stripping the city of apparatus and men.

Exit facilities for Armories should be the same as for other buildings used as places of public assemblage. There are said to have been times when from 5,000 to 10,000 people have congregated in this Armory. It is not difficult to conjecture what could have happened here, or in a similar structure, with even a smoke scare or trouble with the lights, in case 5,000 people tried to leave simultaneously by the single main entrance. Fire Commissioner Hedden, in summarizing the lessons of the fire, said that the heavy monetary cost of the

experience might be well worth the outlay if it will serve to prevent a catastrophe and serious loss of life at some future time.

A fire alarm box should have been located at the entrance of this and similar public and semi-public buildings to eliminate any possible delay in transmitting an alarm.

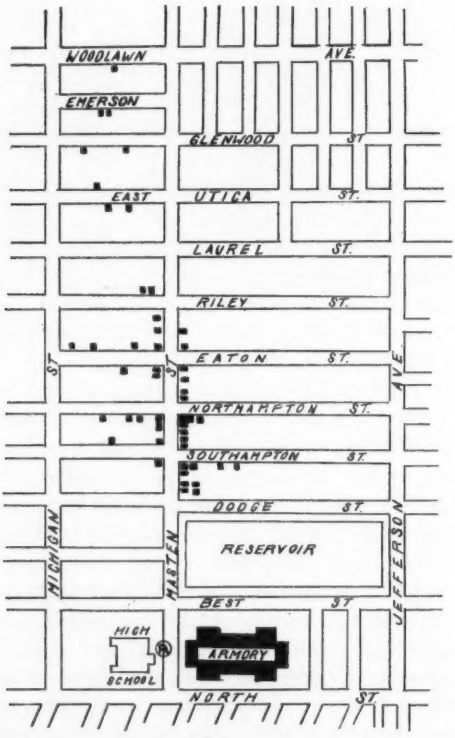


Diagram showing the location of the Armory and some of the fires started from flying brands. Two roof fires occurred more than a mile from the Armory.

Trenton Theatre Fire.

Report by Roy C. Pelham,
Schedule Rating Office of N. J. (Member N.F.P.A.).

On May 2, 1931, at approximately 11:05 P.M., during the showing of moving pictures which followed a vaudeville performance, a fire orginated near the fly gallery on the stage of the Capital Theatre in Trenton, N. J., which resulted in property damage of several hundred thousand dolars. Upon discovery of the fire the asbestos fire curtain was immediately lowered and an audience of twelve hundred persons were requested to make their exit from the theatre, this being accomplished in a quiet and orderly manner. In contrast to many past experiences of theatre fires under similar conditions no lives were lost nor serious injuries incurred, although a severe property loss was suffered.

The building is divided into two sections by a brick fire wall, with small openings unprotected and others protected in a sub-standard manner. The front section, an ordinary constructed building with brick walls three stories and basement in height, covered a ground area of 2,500 square feet and was occupied on the first floor by three stores and a theatre lobby. The second and third floors were vacant lofts. In the roof space of this section the moving picture booth for the theatre was located. The theatre, rear section, was likewise of brick construction and covered a ground area of 12,240 square feet. The stage, auditorium and balcony floors were of reinforced concrete, while the roof (peaked) was constructed of boards on wood trusses with covering of metal and composition.

A brick proscenium wall with an approved type wire woven asbestos curtain (3 lbs. per square yard and 95% asbestos) divided the stage from the auditorium and was manually controlled, with fusible links inserted in emergency release ropes. It was suspended in a sub-standard manner, using wooden supports for anchor chains, which, however, did not affect the final results. There was an approved type stage skylight also provided with fusible links. The fly gallery and grid were of wooden construction. Dressing rooms were on the stage and consisted of three tiers constructed with terra cotta tile walls and partitions, with floors and ceiling of reinforced concrete. A fourth or top tier was of plasterboard with wooden floors.

There were no sprinklers. First aid extinguishers, water tanks, scenery hooks and axes were distributed throughout. No fire hose was provided, and there was no fire alarm box inside the building. The exits were principally on the south and west side of the building.

Story of the Fire.

During the showing of moving pictures and approximately thirty minutes after the last act of vaudeville, an usher in the balcony observed a spark fall

to the stage floor in front of the moving picture screen. He immediately notified the manager of the theatre, who, in turn, investigated backstage, and upon discovering the fire spreading through scenery ordered the fire curtain lowered and the skylight opened. Then, by means of the exit door, he re-entered the auditorium, informed the audience of the fire and requested them to leave the theatre. There was no excitement or panic, and within a few minutes the auditorium was empty. The fire spread rapidly backstage and was soon beyond control, thus forcing stage hands from the building. Actors and actresses had already departed.

One of the audience in the meantime sent in an alarm from a public fire alarm box 250 feet distant from the theatre. Upon arrival of the department flames were leaping high above the stage roof and with such intensity that a second alarm was immediately sent in, and this in turn was followed by a general alarm eight minutes later. All but two pieces of fire apparatus of the city were called.

The fire curtain withstood the effects of the heat for approximately twenty-five minutes before it tore from its batten and fell to the stage. Upon investigating this feature after the fire, the batten was found attached to the anchor chains, which were still connected to the charred wood beams of the grid (this being the unapproved item in method of curtain suspension). It was probably due to intense heat and the cooling effects of the water, together with the pressure from the hose streams, that finally weakened the fabric to such an extent that it collapsed. However, it had already served its main purpose in permitting the audience to make their exit in safety.

The fire up to this time had been confined to the stage portion, but now it was noted by the firemen that a small fire was burning in the orchestra pit. This occurred just before the collapse of the curtain. It is felt certain that the flames passed through an unprotected door opening which formed a communication between the orchestra pit and understage.

Soon after the collapse of the curtain the fire spread to the roof of the auditorium. A possible factor in the spread of the fire to the roof was frame, metal-clad falsework on the outside of the proscenium wall, on the auditorium side of the wall. This falsework served no particular or useful purpose as far as is known. It extended (full width of proscenium wall and twenty-four inches in depth) from within one foot of the proscenium parapet to, and communicated directly with, the large auditorium roof space. Although there was a slight wind in the opposite direction, the flames had reached such proportions in the stage section that it is probable that the one-foot parapet just mentioned was not of sufficient height to prevent the spread of fire to the falsework. Whether it was from this latter feature or the falling curtain, the fire, once under way in the roof space, spread very rapidly and finally caused most of the roof to give way and fall. From here the fire was under control

Proscenium arch, from auditorium. Note remains of frame falsework on proscenium wall in center, and portion of auditorium roof at top.

Rear of auditorium, looking towards division wall between auditorium and store sections. Motion picture booth, above balcony, was not damaged.

and was confined entirely to the theatre building.

It is interesting to note that notwithstanding the proximity of the moving picture booth, neither its equipment nor any of the films suffered any damage. The closing of the shutters by the moving picture operators and the release of the fire doors at the entrance to the booth were no doubt responsible.

Cause of the Fire.

A short circuit in the wiring is believed to have been the cause of the fire, as the manager states that when he investigated backstage there was a wire extending over the top of the drop curtains. A rumor prevailing after the fire was to the effect that the use of a flash powder in the last act contributed to the cause. The equipment in which the flashlight powder was used was destroyed in the fire.

Ruins of the Capital Theatre, Newark, N. J., after the fire of May 2, 1931. Stage section in the left foreground, auditorium beyond.

Extent of Damage.

Practically the entire interior of the theatre section, except reinforced concrete floors, a small foyer, and a portion underneath the balcony was damaged. The latter two sections were damaged by water only. The mercantile section suffered only from water damage in the basement, as the water seeped from the auditorium floor to this basement. There was no damage to surrounding properties.

Conclusions.

The following conclusions may be drawn from this fire:

1. The asbestos fire curtain served its main purpose by preventing the spread of fire to the auditorium until sufficient time had elapsed to permit the audience to safely leave the building.

2. That with an approved system of automatic sprinklers over the stage the loss might have been considerably less. Because of the combustible contents usually found backstage in theatres, automatic sprinkler protection should be mandatory.

3. The delay in transmitting the alarm due to lack of fire alarm box in the building allowed the fire to gain considerable headway before the firemen arrived. An adequate number of fire alarm signal stations should be distributed throughout a theatre, particularly on the stage, near the motion picture booth, and the main exit.

4. All roof superstructures should be constructed of fire-resistive or at least incombustible material that will not contribute to the intensity or spread of the fire, and parapet requirements should be observed.

5. Whether or not the flash powder was a contributing factor in the cause of the fire, all acts using flash powders and other spark or flame emitting devices should be carefully arranged and precautionary steps taken that will properly guard the attendant fire hazard.

St. John, N. B., Waterfront Conflagration.

One of the most disastrous fires which have occurred in the Dominion of Canada since the Halifax disaster of 1917 occurred on the morning of June 22, 1931, in a pier shed on the waterfront at St. John, and before it could be brought under control swept the greater part of the West St. John harbor front. Early reports placed the loss at $10,000,000, but later estimates indicate that the total loss will be in the vicinity of $5,000,000.

Property Involved.

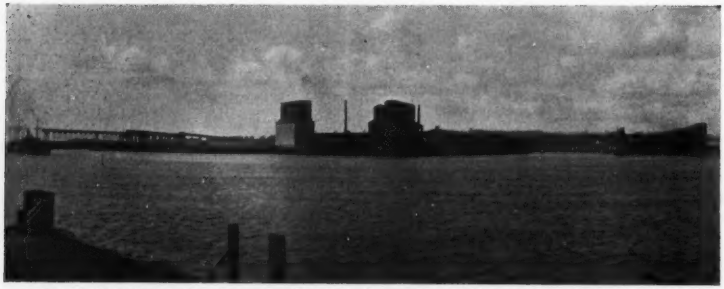
The property involved in the fire included the principal portion of the water front area on the West St. John side of the harbor, embracing the wharves and pier sheds of the St. John Harbour Commission; grain conveyors, elevator, and rolling stock of the Canadian Pacific Railway; immigration and customs sheds of the Dominion Government; a fertilizer plant; and about seven dwellings on Protection Street. A number of small vessels and the Canadian Pacific Railway steamer *Empress* were also burned.

The wharves involved were, for the most part, of piling and timber crib construction, with one-story frame pier sheds or warehouse. Pier No. 16 was of concrete with dirt fill, and pier No. 17 was of concrete with crib and piling for the foundation of the pier shed. The pier sheds varied in length and area from approximately 400 feet long with an area of 23,000 sq. feet to 1100 feet long with an area of more than 50,000 sq. feet. The pier shed in which the fire originated was one of the largest of the group, being, with its extension, 1055 feet long and having a total area of 40,040 square feet.

There were two grain elevators adjacent to the piers, one of frame construction having a capacity of 600,000 bushels, and the other of concrete with 1,000,000 bushels capacity. This latter structure was not destroyed, but suffered fire and smoke damage when fire entered by way of conveyors. Frame grain conveyors totaling 6150 feet in length led from the various piers to the elevators, most of which were destroyed.

The other buildings involved were of frame construction, the fertilizer plant located near the new No. 17 pier shed being recently completed, and No. 17 pier shed itself being under construction. The steamship *Empress,* which was alongside pier No. 7, had not been in use for a year and could not be moved owing to low tide. The freight office of the C. P. R. was saved by the efficient work of the fire department.

This report has been made possible through the courtesy of Hugh H. McLellan, Fire Marshal of New Brunswick (Member N.F.P.A.) and the New Brunswick Board of Fire Underwriters (Member N.F.P.A.), who have furnished data, newspapers and photographs of the St. John conflagration. Acknowledgment is also made to the St. John *Telegraph-Journal* for data extracted from their columns.—Ed.



West St. John, N. B., waterfront before the conflagration of June 22, 1931. The fire had its origin on pier No. 7, at the extreme right of the picture. Note wooden grain conveyors, said to have been an important factor in the rapid spread of the fire. All the structures shown in this picture, except the new concrete elevator, were destroyed.

Fire Protection.

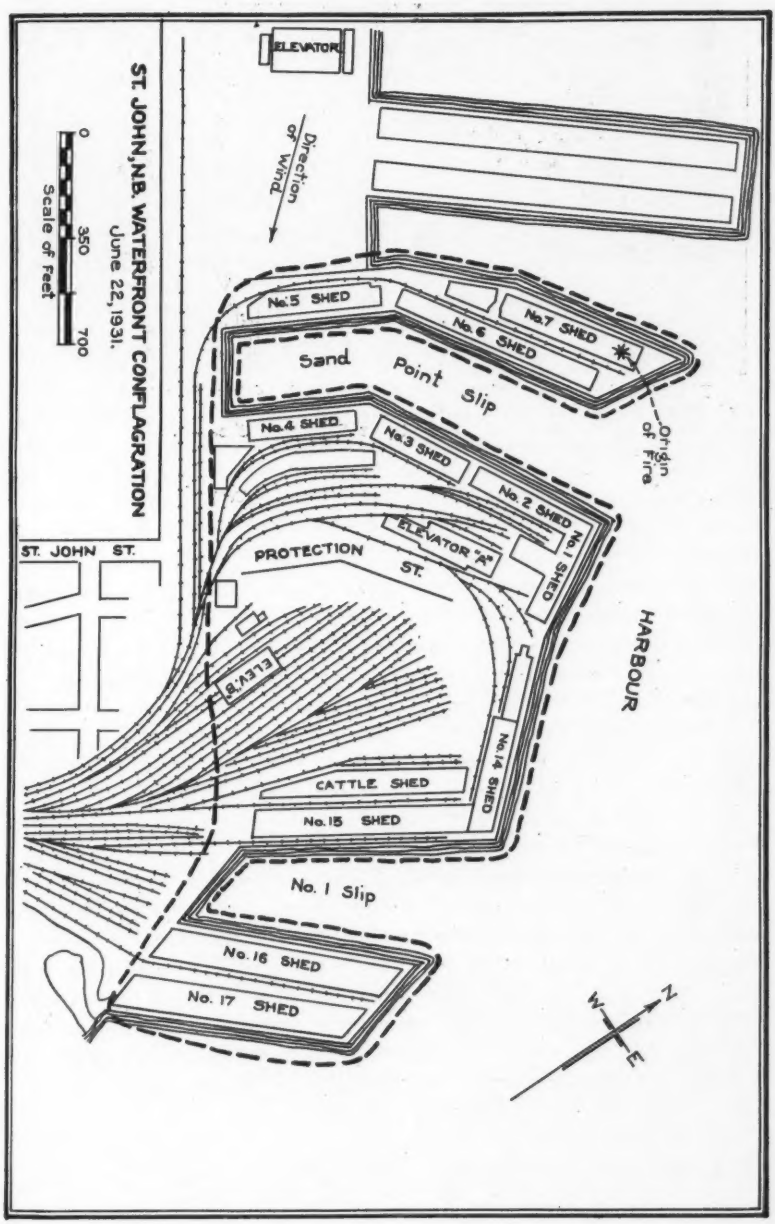
Private fire protection consisted of standpipes and hose distributed throughout the pier sheds, together with fire extinguishers. Fire hydrants were available in the areas at the land side of the sheds, and two standpipes with deluge hydrants covered the area. All sheds were equipped with the city automatic fire alarm system. In the immigration shed there was an automatic sprinkler system.

The fire protection available at pier No. 7, on which the fire originated, consisted of one standpipe and monitor nozzle on the warehouse side and another on the track side. There were two hose reels, each having about 600 feet of cotton rubber lined hose. Six five-gallon fire extinguishers were hung on posts in shed No. 7, and one five-gallon fire extinguisher was provided in each of the five offices that were in the shed. City water mains extended to shed No. 7, with three fire hydrants on the track side of the shed, two on the wharf side, one inside the shed and two inside the extension of shed No. 7. Four harbor police officers were on duty at sheds Nos. 6 and 7, and one officer with a watchman's clock covered sheds Nos. 5, 6 and 7 at regular intervals.

City fire protection immediately available consisted of the West St. John fire station, located about three minutes' run from the waterfront, equipped with a 1000-gallon triple combination pumper. All other public fire protection equipment was located on the east side of the harbor and consisted of seven fire stations fully equipped. There was also a fire station in the parish of Beaconsfield, just over the city line on the west side. In this station was a 1000-gallon triple combination pumper, which responded immediately to the fire upon receiving a request for aid from the St. John fire department.

Story of the Fire.

The fire was discovered at about eleven o'clock on the morning of June 22 in shed No. 7, at the extreme western end of the Harbour Commission's


ST. JOHN, N.B. WATERFRONT CONFLAGRATION
June 22, 1931.
0
350
700
Scale of Feet
ELEVATOR
Direction of Wind
No. 5 SHED
No. 6 SHED
No. 7 SHED
Sand Point Slip
Origin of Fire
No. 4 SHED
No. 3 SHED
No. 2 SHED
No. 1 SHED
ELEVATOR "A"
ST. JOHN ST.
PROTECTION ST.
HARBOUR
G.T.R.
CATTLE SHED
No. 14 SHED
No. 15 SHED
No. 1 Slip
No. 16 SHED
No. 17 SHED
N
W
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The St. John conflagration at noon. When this picture was taken the fire had swept across Sand Point slip and involved all sheds in the central group except shed No. 15, which was apparently just igniting. Shed No. 16 and the new shed No. 17 seemed safe at this time.

property. At the time of the fire the steamer *Gundersen* of the United Fruit Co. was unloading a cargo of bananas, and there was considerable hay, used for packing purposes, in the pier shed. The exact cause of the fire has not been determined, but it is thought it may have been due to the careless disposition of a cigarette. Smoke was first seen coming from the vicinity of a toilet at the eastern end of the pier shed, and it is the belief of Chief W. S. Vaughan of the fire department that the fire started at this point and worked its way under the floor.

Upon discovery of the fire the private fire fighting equipment was brought into use and attempts were made to extinguish what appeared to be an insignificant blaze. At 11:15 A.M. an alarm was turned in to the fire department, and the pumper from the West St. John station, together with the pumper from Beaconsfield, responded. The West Side pumper was driven into shed No. 7 in order to approach what was thought to be a minor fire and extinguish it by means of a chemical stream. When well into the shed smoke and flames burst out from underneath, enveloping the apparatus before it could get into action, and it had to be abandoned. The crew of the pumper barely escaped with their lives. By 11:30 A.M. the entire pier shed was on fire and flames were communicating to adjoining structures. The steamer which was docked at the pier was moved into midstream to keep it from burning.

In the meantime Chief Vaughan had been notified of the extent of the fire, and at 11:40 A.M. an alarm was sounded summoning the entire St. John fire department with the exception of one unit. The fire had by this time gained such headway and become so intense that the fire department could do little or nothing to prevent the spread of the flames along the waterfront. By

noon the entire pier on which were located sheds Nos. 5, 6 and 7 was a mass of flames.

Driven by a brisk northwest wind, the fire jumped across the slip to shed No. 2. A spectacular scene was presented when the pilot schooner *Glooscap*, docked alongside of shed No. 4, caught fire, while the C. P. R. steamship *Empress* was a mass of flames at the western end of shed No. 7. The fire continued to spread through the sheds adjacent to No. 2, and by one o'clock the entire area east of Sand Point Slip was involved, including the old C. P. R. frame elevator, power house and other railway property. These structures caught at about the same time that sheds Nos. 14, 15 and 16 became involved.

The fire spread from this point to seven houses on Protection Street (which led down to the elevator), and they were completely destroyed together with their contents. It was not thought that the fire would jump the wide slip beyond shed No. 15, but by two o'clock shed No. 16 on the most easterly pier was on fire, and flames were spreading to the fertilizer plant near by and to No. 17 shed, in spite of the efforts of firemen who had several streams at this point. This latter shed was under construction and as it was not thought that the fire would reach this point, men were working on it practically up to the time it was ignited.

Flames traveled through the grain conveyors and worked their way along the belting of one of them into the large C. P. R. concrete elevator "B," start-

Almost the entire waterfront of West St. John was wiped out when the Harbour Commission's wharves and the C. P. R. elevator were destroyed. This picture, taken at the height of the fire, shows the relation of the devastated area to the rest of the port development.

St. John Telegraph-Journal.

Waterfront area, St. John, N. B., after fire of June 22, 1931. At the left are the ruins of pier shed No. 7, where the fire started. The chimney of the old grain elevator is shown standing near the foot of Protection Street, where seven houses were burned. In the center is the new elevator, which was but little damaged. At the right the ruins of sheds 15, 16 and 17.

ing several small fires within the elevator and filling the building with smoke. These fires were extinguished without serious loss, but the damage from fire and smoke was estimated at $20,000.

In the area between No. 7 shed and No. 17 there were many empty box cars owned by the C. P. R. on the tracks adjacent to the warehouses and in the yards. Just how many were destroyed is not known, but it is stated that at least 125 cars were lost. At No. 7 shed there were fifteen refrigerator cars, seven of them loaded with bananas. These were pulled out by a switching engine to Union Street, where firemen extinguished the fire in them, but cars and freight were ruined.

How the Fire Was Fought.

By the time the firemen from the East Side arrived it was impossible to get down Protection Street or on to any of the wharves to which the fire was spreading. For this reason the work of the fire department was centered on preventing the fire from crossing Union Street, as well as keeping water playing on the buildings and railway cars that were in the path of the flames. Three 750-gallon pumpers and one 1000-gallon pumper were used, and fifteen lines of hose were in operation from hydrants on Union and St. John Streets. Some of the hose lines were 500 feet or more in length. In addition to the loss of the pumper from the West St. John station, approximately 1500 feet of hose was destroyed when the rapid spread of the fire forced the firemen to retreat before they could shut down and uncouple their lines. The water supply appears to have been adequate.

In addition to the city's fire fighting forces, the tugboat *Ocean Hawk* was requisitioned into service as a fireboat. A position was taken at the eastern end of No. 7 pier shed, and the stream from the boat was effective in extinguishing the burning ruins of the wharf. Other tugs assisted likewise at the harbor end of other piers.

Nothing could be done to prevent the burning of the pilot boat or the steamship *Empress*. The former was a sailing vessel. Attempts were made to move it, but had to be abandoned because of the intense heat of the spreading flames. The *Empress* was docked in an undredged slip and, due to low tide (the rise and fall of tide at St. John is from 22 to 28 feet), she was resting in mud and could not be moved. There was no chance for firemen to get down the wharf to direct streams of water on these vessels.

The frame grain conveyors were one of the chief factors in the rapid spread of the fire. Attempts were made to retard the progress of the fire by the use of dynamite to blow up sections of these conveyors. Efforts in this direction were only partly successful, and with the exception of a small section leading from the concrete elevator to No. 16 shed, all grain conveyors were destroyed. This section was said to have been saved by the use of dynamite.

Loss.

Although press reports stated the loss to be as high as $10,000,000, this figure seems high in view of later estimates. The Harbour Commission, who own all the piers and sheds, estimate their loss in the vicinity of $3,000,000; the C. P. R. loss was estimated at approximately $1,000,000; and the loss to the new pier shed not included in the Harbour Commission's estimate was $160,000. To these losses must be added the loss to the fertilizer plant, various Dominion Government buildings, the S.S. *Empress* and other vessels, all of which might easily make an additional amount of $1,000,000. The total loss, therefore, appears to be in the vicinity of $5,000,000, probably not more than 20% of which was covered by insurance. Definite figures, however, are not yet available.

It is unfortunate that one life was lost, that of an accountant for the United Fruit Company. He was trapped in his office in pier shed No. 7 by the rapid spread of flames while attempting to salvage papers and books of the company.

Conclusions and Remarks.

There is no new lesson to be learned from this fire. The large area of combustible construction housing highly combustible contents and lacking automatic fire protection offered plenty of opportunity for the spread of fire once it got started under favorable conditions. Like other pier fires of recent occurrence (New Orleans, La., see QUARTERLY, April, 1930, Vancouver, B. C., see QUARTERLY, October, 1930, and Norfolk, Virginia, in this issue of the QUARTERLY), the rapidity with which the fire spread was almost inconceivable.

Ruined piers at West St. John, showing timber crib construction and damage wrought. Note how intense heat warped and twisted railway tracks.

The pier on which the fire started was involved within twenty minutes from the time of discovery, forcing the fire fighters to abandon their apparatus and retreat. In less than three hours the entire dock and railway yard area was a mass of flaming ruins.

The value of a sprinkler system is obvious, and had pier No. 7 been so equipped it is probable that the fire would have been extinguished in its incipiency before it could work its way under the pier decking. Proper fire stops below the pier deck would have prevented its lateral spread under the pier. It is to be noted that the Dominion Government immigration shed was equipped with automatic sprinklers, but the fire, due to exposure, was too severe to be controlled by their operation.

Such a fire as this was predicted by a Montreal fire prevention engineer, who made a report on the fire hazard of this area at the request of the New Brunswick Board of Fire Underwriters. The report, which was submitted to city authorities and the St. John Harbour Commissioners, stated that an extremely bad hazard existed and that unless essential precautions were taken a fire, under favorable conditions, would sweep the property. Plans were submitted which provided for the installation of a sprinkler system and provision for a fireboat. The New Brunswick Board of Fire Underwriters have from time to time endeavored to have the hazard of the property lessened, but without success. It is contended that had these recommendations been carried out the West Side waterfront would have been saved.

City Gas Explosions.

Gas, manufactured or natural, is generally piped throughout cities, and with such widespread distribution of gas that is explosive when mixed with air in certain proportions, occasional explosions may be expected. The following summary compiled from reports on file with the N.F.P.A. Department of Fire Record is presented as a typical record of gas explosions occurring during the past six years. Like other N.F.P.A. fire records, it is not intended as a complete statistical record of all the explosions that have occurred.

Gas plants have been previously covered in separate fire records (QUARTERLY Vol. 19, No. 3, p. 284; Vol. 20, No. 3, p. 285; Vol. 21, No. 3, p. 218) and are not included in the present record. Likewise portable cutting and welding equipment (see QUARTERLY Vol. 24, No. 1, p. 23) and other processes using gases such as acetylene and hydrogen are considered to be outside the scope of the present record.

The following summaries describe gas explosions that have occurred from 1925 to date, a period of six years. The sources of the information are reports of insurance inspection organizations, supplemented in some instances by reports of governmental investigations, and newspaper accounts. Analysis of these reports shows that in the majority of cases the explosions have been chargeable to the neglect of recognized fire safety precautions, and that the losses might have been minimized by compliance with the recommendations of the N.F.P.A. Committee on Gases.

Unlike most fire record compilations, it has been found difficult in this instance to consolidate the essential data relative to occupancies, causes, losses, into tables. Instead it has appeared more satisfactory for the purpose of analysis to divide the explosion experience studied into five groups and present brief summaries of typical explosions in each group. The five groups are as follows: explosions in industrial installations or process heaters, explosions in gas-fired baking ovens, explosions in mercantile and institutional occupancies, explosions in dwellings, and explosions in sewers, manholes and street mains.

Explosions in Industrial Installations.

Thirty-two reports of gas explosions and fires incident thereto in industrial plants were analyzed and brief accounts of typical experiences appear below. Of these thirty-one fires studied, twenty-one occurred in metal working plants, two in carbon works, two in wire mills, and the remainder in miscellaneous types of manufacturing plants. Japan ovens, core ovens, and gas machines were the principal process heaters involved in these fires. A study of these fires indicates that carelessness in operation was the predominating factor in the majority of cases.

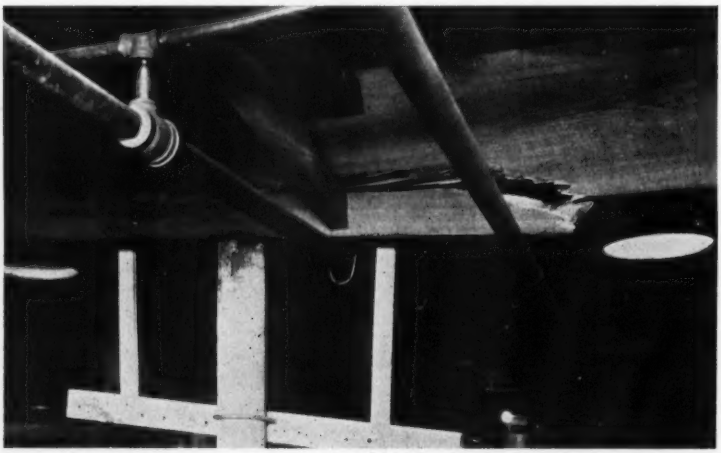
Leaks in Gas Mains.

DECEMBER 13, 1926, NORWOOD, O. METAL WORKER. It was the custom of the watchman, after completing his five o'clock round each morning, to start the gas mixing machines in the basement, which supplied a gas and air mixture to soldering machines, and then go through the plant and light the burners at the various soldering machines, after which he returned to the basement.

On the morning of the fire the usual procedure had been followed and the watchman had returned to the basement and found everything apparently operating satisfactorily. He noted a slight odor of gas but thought nothing of it. When he was ready to leave he turned off the electric light. A spark resulted, and immediately there was a mild explosion with a flash of flame throughout the room which ignited the oil soaked ceiling.

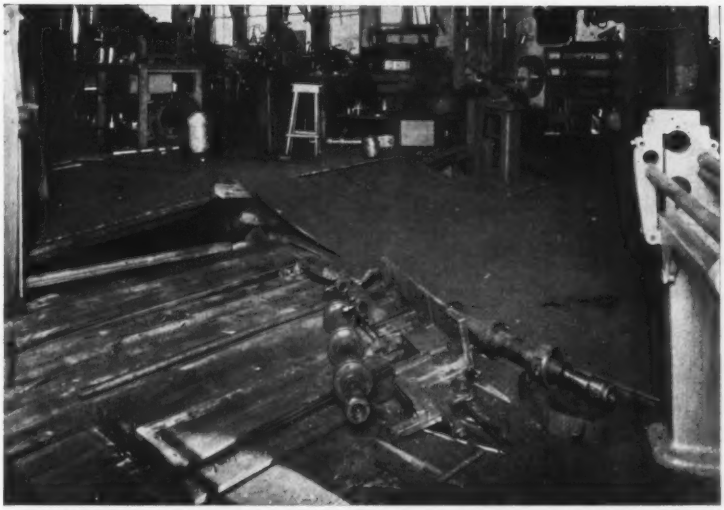
Presumably gas had accumulated from a small leak in the poorly supported 4-inch pipe, at a screw joint which was found to have been engaged by only two or three threads and which had probably opened slightly under the vibration of the gas machines. This gas, being natural gas, has very little odor, and a considerable quantity may accumulate before the sense of smell gives warning.

A few sprinklers opened, but did not extinguish the fire entirely, because the heads were located directly under the centers of the 6-inch by 14-inch beams, so that water could not reach parts of the ceiling alongside the beams. The explosion broke the weak joint in the 4-inch gas main, but the escaping gas did not ignite at once.



Factory Mutual Record.

When escaping gas in the basement of a Norwood, Ohio, metal working plant was ignited by a spark from an electric light socket, the force of the explosion was sufficient to crack a 14 x 6-inch floor beam.



Factory Mutual Record.

Another view of Norwood, Ohio, explosion, showing damage to floor directly above explosion area in basement. The pressure thus vented into the first story blew out all windows in this room.

The watchman was severely burned by the flash, but he managed to crawl on hands and knees up the stairs out of the basement. He was making his way to a telephone when a second very violent explosion occurred. The plant engineer, attracted by the first explosion, was then at the top of the basement stairs, ready to go down. He was thrown ten feet and knocked unconscious. This second explosion was due to the rapid accumulation of gas from the broken main, forming an explosive mixture which was ignited by the fire which still burned in the ceiling.

The remainder of the thirty-nine sprinklers in the basement opened in the second explosion, but had no water because the riser had broken both at the first and at the second floor levels. The stream of gas from the broken main was ignited by the second explosion, and was burning in a big jet of flame. One of the firemen donned a gas mask, entered the basement, and closed the main gas valve. The fire in the ceiling was then quickly extinguished with hose streams.

The force of the explosion lifted one portion of the basement ceiling upward twelve inches, venting the pressure into the first story, where all of the windows were blown out and several heavy machines tipped over. One large 6-inch by 14-inch beam was broken, and several others were lifted from supports in the concrete piers.

The only damage done by the fire was the charring of small areas of ceiling. The large broken beam and two others had to be replaced, along with

some flooring in the first story. Window glass, fire doors, belting, and some equipment were also replaced. Water damaged office furnishings in the first floor and finished machine parts stored in the basement. The loss was $5086.

This fire teaches three lessons—that gas piping should be well supported to protect against breakage. Threads at joints should be made up fully to prevent loosening from vibration; that gas mains entering buildings should be equipped with an accessible outside control valve; and that gas mixing machines are most safely located in a detached building. When necessarily inside a main building, they should be near an outside wall in a substantial, non-combustible room, well ventilated and with ample explosion vents to outdoors. Electric lamps should be vapor-proof, with switches located outside the room. (S-44206.)

DECEMBER 14, 1927, FOSTORIA, O. CARBON WORKS. This explosion occurred in a 700-foot concrete tunnel for pipes carrying steam, water, air and natural gas, connecting a group of new buildings under construction. This tunnel was five feet wide and ten feet high.

The gas pipe had welded joints and had been satisfactorily tested on December 4. On December 14, after further inspection, gas was turned into the pipe. At the time four electricians were at work connecting leads to transformers set in alcoves of the tunnel. They were using an electric drill.

Suddenly a violent explosion occurred. A mixture of natural gas and air had formed in the tunnel, and was ignited either by a spark from the drill or a lighted match. Several hundred feet of the 6-inch reinforced concrete roof-slab heaved upward, broke, and fell into the tunnel. The force of the explosion was transmitted through openings into the first story of adjoining buildings. It blew out more than two hundred feet of steel window sash and one hundred feet of brick curtain wall, some of it clear away from the steel frame; bulged five large steel rolling doors beyond repair; and heaved portions of the brick floor set in sand. Windows across the street were broken.

The full explosion pressure enveloped the men in the tunnel, but they were not seriously hurt. The alcoves sheltered them somewhat from the falling débris of broken concrete and wrecked piping. Inside the building, an electrician on a ladder near one of the tunnel manholes was blown against the wall and fatally injured.

After the explosion, a two-inch uncapped end was found on the gas pipe. The cap had probably been removed since the test, had escaped discovery, and let gas escape when the valve was turned on. The pipe itself was not ruptured and later stood a water pressure test of one hundred pounds.

Four hundred feet of the tunnel was wrecked. The transformers were apparently undamaged, but lead-sheathed power cables being drawn through ducts in the concrete walls were broken in several places. The steam line sup-

Factory Mutual Record.

An uncapped end of a gas main filled a pipe tunnel at this metal working plant in Fostoria, Ohio, with an explosion mixture of natural gas and air. This mixture was probably ignited by a spark from an electric drill which was being used in the tunnel by electricians.

plying the old building group from the new boiler house was also broken; but the boilers at the old group were again started, so that production was continued after only an hour's interruption. The loss was roughly estimated at the time to be between $40,000 and $60,000. (S-46557.)

NOVEMBER 9, 1929, ELYRIA, O. METAL WORKER. An explosion occurred in this plant shortly before 7 A.M., causing the death of six persons and seriously burning four others. Of the dead, five were men and one was a woman. The resulting fire was not serious and was extinguished with little difficulty by the fire department. The terrific force of the explosion, however, completely demolished all of the building except a small one-story section in the rear.

It was brought out at the inquest that there was a leaking gas main in the building. The explosion took place shortly after a 10 to 14 lb. pressure of gas had been turned into a two-inch main leading to the factory, which had previously been carrying a four-ounce gas pressure. In this line there was a ¾-inch hole which permitted gas to escape through the floor of the building and accumulate in the interior. The manner in which this gas was ignited has not been fully established. An employee first stated that a cigarette was the cause, but later denied this, and no other definite evidence has been discovered.

It is estimated that about 180,000 cubic feet of fuel gas were involved.

Considerable damage was done outside the plant by the force of the explosion. A large number of dwellings and buildings at some distance from the plant had windows broken. A laundry plant adjoining had all its windows blown out, its walls caved in, and severe damage to machinery and clothing in process. A garage and frame building on the other side of the plant were completely wrecked.

Just how the victims lost their lives is not known, but all were burned by the sudden flash of fire. Four of them died instantly from the effects of the explosion, while two were dragged from the building with their clothing in flames and died later at a hospital. The four injured suffered burns about the face.

Details as to loss are not available, but press reports placed it at about $100,000. (H-28723.)

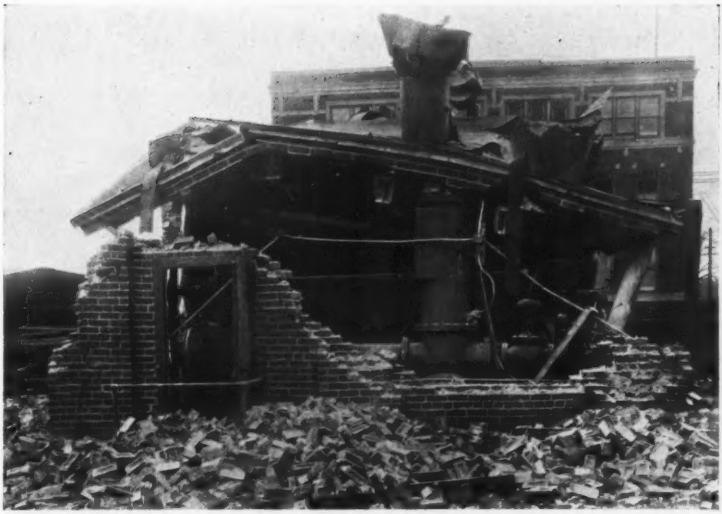
Defective Gas Machine.

JANUARY 29, 1929, SEATTLE, WASH. METAL WORKER. As the watchman approached the gas room on his regular rounds at 4:30 A.M., carrying a kerosene oil lantern, an explosion occurred. The gas room was apparently filled with an explosive mixture of gas and air, which was ignited by the lantern. Heat from the ensuing fire opened three sprinklers which, when the gas was shut off, extinguished the fire.

The cause of the escape of gas into the room is thought to have been a leaky check valve on a 3000 cu. ft. capacity gas mixer. The only gas used from this machine during the night was on a dry oven, and due to trouble at the oven the gas had been shut off, but the gas machine continued to operate, by-passing all the mixture. A leaky check valve was found on the machine, and it is thought that gas worked through this valve back into the gasometer. The pressure created in the gasometer caused the gas to bubble up through the water seal, filling the room with gas. There was a vent from the gasometer leading outside and several window panes had been removed to assure circulation of air in the gas room. However, the weather was extremely cold and the watchman had plugged these windows with boards and rags, not realizing the danger of gas filling the room.

The principal damage was due to the collapse of a hollow tile wall between the gas room and a stairway, the destruction of about 80 feet of steel and glass partition and broken window panes in the basement. The loss was estimated at $850. (S-50875.)

JANUARY 14, 1929, MILWAUKEE, WIS. MACHINE SHOP. City gas used at heat-treating furnaces was compressed by two compressors. Water was used in the compressors and the mixture passed through a separator, from whence the water was piped to a sewer manhole. To this same manhole was a drain (not trapped) from a pipe trench in the heat treating building.



Factory Mutual Record.

When gas escaped from a valve accidentally left open in the gas compressor room in a Hamilton, Ontario, metal working plant, an explosive mixture was formed which was ignited by an arc at the light switch when the operator attempted to turn on the lights.

Employees had for some time smelled gas in this building, and about a week previous had found a small leak in a gas pipe near a furnace. The leak was stopped, but the odor of gas still persisted. No further leaks could be found, however.

On Sunday, January 13th, at 3:00 P.M., the gas compressors were started in order that the ovens would be hot when the night shift came on at 11:00 P.M. At 1:05 A.M. a violent explosion occurred, blowing off about 100 feet of cast iron trench covers. About 200 wired glass windows on the side walls and in the sawtooth roof were cracked. Ten steel sashes were also badly damaged. The windows in the east side and in the roof were blown outward; those on the west side were pulled in apparently by the vacuum following the explosion. Four trench covers were broken, an electrical panel board was damaged, and a traveling conveyor thrown out of line. Apparently no damage was suffered by electrical heat treating furnaces located near the trench. The flash seriously burned one man and slightly injured two others.

After the explosion an examination disclosed a leak in one of the gas compressors. This allowed gas to escape into the sewer and then back up through the drain pipe to the pipe trench. An explosive mixture was formed and probably ignited by one of the burners at a furnace or by hot metal. The loss was estimated at approximately $1200.

Gas Meter.

NOVEMBER 8, 1928, CAMDEN, N. J. AUTOMOBILE BODY PLANT. A gas meter 30 in. by 26 in. by 40 in., located about 12 feet from the boiler in a fire-resistive boiler room, failed without apparent warning, releasing gas into the boiler room. The fireman was killed in the resulting explosion and fire. After the explosion the 3-inch gas pipe, with which the meter was connected, continued to burn until extinguished by a fire department hose stream directed through a basement window. There was no damage to the structure or contents. (H-29672.)

JULY 30, 1930, CHICOPEE, MASS. METAL WORKER. Air under pressure was piped to a gas burner in a gas heated furnace. The air worked back into the gas supply pipe, forming an explosive mixture. When the burner was lighted, fire flashed back in the pipe and the gas meter exploded. The meter was wrecked, a number of windows were shattered, and the gas escaping from the meter was ignited. The resulting fire was extinguished by three automatic sprinkler heads, aided by a hose stream used by employees. The loss was estimated at $150. (S-53659.)

Inadequate Ventilation.

FEBRUARY 4, 1928, PITTSBURGH, PA. METAL WORKER. On cold nights it was customary to light a gas-fired furnace in the forge shop to prevent water lines from freezing. A workman lit the gas but neglected to start the ventilating fan which carried the fumes away from the furnace. This caused gas to back up in the ventilating pipes, and the explosive mixture was ignited by the furnace. The ventilating pipes were blown down and the fan put out of commission. The loss was estimated at $330. (S-48590.)

AUGUST 13, 1928, KOHLER, WIS. METAL WORKER. The gas heated core oven in which this explosion occurred was of steel frame construction with sheet metal sections filled with mineral wool. Just after the foreman had started to light the gas burners there was a terrific explosion. This explosion completely ruptured the oven slabs, blew out all the windows and damaged a good portion of the sashes in the north and west walls of the building. All wired glass in the monitor roof of the building was badly cracked.

Although the foreman had been instructed to first start the ventilating fan to remove any accumulation of gas from the oven, he did not do so on this occasion, with the result that the accumulated gases ignited. The loss was estimated at $1500. (S-26585.)

MAY 29, 1929, FOSTORIA, O. CARBON WORKS. Two furnaces made of fire brick with an insulating brick shell reinforced by steel rods were in use at this plant. They were heated by means of natural gas through ten burners on each side at the base and ten burners on each side about six feet above the base. The heat rose in a duct from each burner and was admitted to the furnace at the top.

Factory Mutual Record.

Hamilton, Ontario, metal working plant, showing damage to building eighty feet away from gas compressor house, where explosion occurred.

At about 11:00 P.M. a violent explosion occurred in one of these furnaces, lifting the brick arch roof of the furnace and damaging the walls, and also blowing out a section of steel window sash at the opposite end of the building. It is thought that the explosion may have been due to faulty ventilation. The loss was $1600. (H-31639.)

DECEMBER 31, 1929, DALLAS, TEX. AUTOMOBILE ASSEMBLY PLANT. The brick settings at two boilers in the power house were destroyed at 12:20 A.M. by an explosion caused by failure to ventilate the boiler previous to lighting. Many lights of glass in the power house were broken and two boiler feed pumps were damaged. Both the engineer and fireman were severely injured, the latter also being burned by the flash-back.

This explosion might have been averted had openings been provided in the damper of each boiler so that all draft could not have been shut off. Only a small amount of ventilation through the 75-foot stack would be necessary to free the boiler of gas. An automatic gas valve to each boiler, interlocked with the damper, would prevent the flow of gas before proper ventilation of the boiler. The loss was estimated at $5500. (H-31634.)

Accumulation of Gas.

MAY 10, 1929, CICERO, ILL. METAL WORKER. When gas burners located under a dryer were lighted an explosion occurred in the combustion chamber, due to an accumulation of gas. The force of the explosion was both downward and upward, damaging the combustion chamber itself and the contents of the oven above. Heating tubes were bent and disarranged. Positive ventilation should have been provided by means of a motor-driven direct connected fan interlocked with the gas supply to the oven. The loss was $400. (H-31640.)

JUNE 20, 1929, ARNOLD, PA. METAL WORKER. This explosion involved a gas fired melting furnace. The gas pipe supplying fuel to heat the furnace was

broken by the explosion, and escaping gas ignited. The brick top of the furnace was blown off and the sides badly damaged, causing a loss estimated at $3500. The explosion was due to an accumulation, in the gas piping, of compressor lubricating oil or gas condensate, which was forced through the burners into the furnace. The excess fuel temporarily depleted the oxygen and extinguished the fire. Gas and air from the burners then formed an explosive mixture which came into contact with the hot walls of the furnace and ignited. (H-31638.)

JUNE 23, 1929, TOLEDO, OHIO. BRASS FOUNDRY. A series of brass furnaces, with gas and air mixed at the burners, were supplied with city gas at 25 oz. pressure, and with air through a system of ducts at 20 oz. pressure from a motor-driven blower in the basement. While these furnaces were shut down during the week end period a severe thunder shower occurred. During the storm lightning ignited a mixture of gas and air in the air blower ducts, resulting in an explosion which damaged the ducts to the extent of $500. Apparently gas had leaked back through the burners into the air ducts, forming the explosive mixture. (H-31637.)

JANUARY 14, 1930, SOUTH BEND, IND. TEXTILE MILL. A gas-fired boiler was supplied with gas from a main header located behind the boiler. This main header fed six or eight individual burners under the boiler, each having its own shut-off valve.

The foreman, presuming that all burner valves as well as the main feed valve had been tightly closed while the burner was not in use, turned on the main valve and then walked around to the boiler doors and stuck in the lighting torch. It appears that some of the individual burner valves had been left open, and sufficient gas had accumulated to cause a violent explosion which threw the man several feet. (H-31631.)

FEBRUARY 10, 1930, MUSKEGON, MICH. FOUNDRY. At about 6:00 P.M. the burner for a core oven was lighted. Apparently the flame in some way became extinguished and the oven filled with natural gas. When the near-by cupola was drawn at 6:27 this accumulated gas was ignited by sparks through leaks around the doors or ventilating stacks.

The resulting explosion blew off the roll-type door on one end of the oven and bulged a section of metal lath and cement plaster wall of the building. About 100 panes of glass were broken. The composition chamber and brick flue of the oven were largely destroyed, together with 583 cores that were in the oven. The loss amounted to $1400.

Had this oven been provided with an automatic pilot light, which if extinguished would shut off the gas supply, this explosion would not have occurred. (H-31630.)

Explosions in Gas-Fired Baking Ovens.

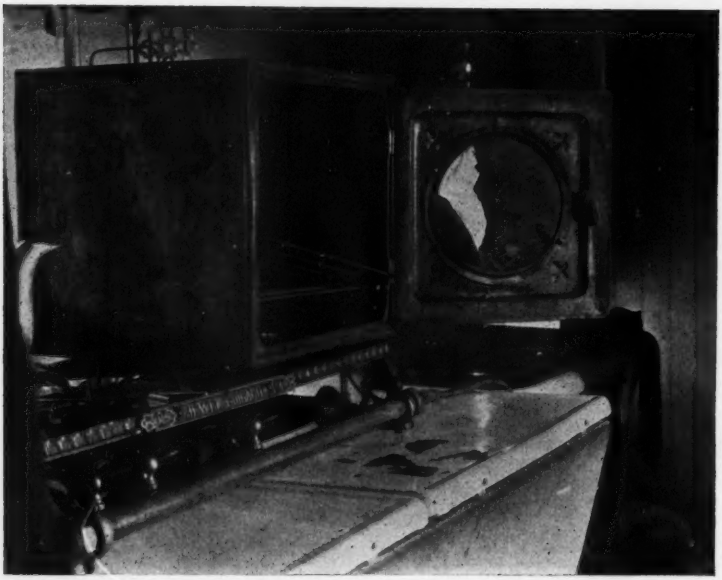
Gas heated baking ovens are found not only in hotels, restaurants and bakeries, but in millions of homes as well. Regardless of the size of the equipment or the purpose that it serves, one hazard, the possibility of explosion, is common to all. Fortunately, accidents of this kind are infrequent in comparison with the number of ovens in use, yet the danger is ever present unless the necessary but simple precautions are taken.

By way of illustration, there follow brief accounts of four explosions of this sort, the ovens involved being all used in the preparation of food, three being of the commercial type employed in a large bakery, and one being a small portable domestic oven. Such explosions are due to accumulations of gas in the oven, when the gas as it flows into the oven is not immediately ignited. This may be due to turning on the gas before a source of ignition is supplied, the failure of a pilot light or electric igniter, or extinguishment of the flame owing to temporary low gas pressure. Various automatic devices are installed to eliminate this hazard, but the record shows that common caution should always be observed even where automatic devices are installed, and that if for any reason unburned gas accumulates in an oven, it should be thoroughly ventilated before any attempt is made to light the gas.

The oven shown in the illustration is of a type familiar to most housewives. This oven was used with a gas hot-plate, and the gas had been burning under it for some time previous to the explosion. The flame was exposed to a draft from an open door, and as the gas was probably "turned low," the flame was blown out by the current of air. The housewife presently came to investigate the condition of the food that was in the oven, and finding the gas flame extinguished, relighted it without opening the oven door. A violent explosion immediately followed, blowing the door open and damaging the oven and its contents. In addition, the hot blast singed the woman's eyebrows and hair, but fortunately caused no more serious injuries. The oven undoubtedly became filled with an explosive mixture of gas and air while the flame was extinguished, and the explosion occurred when the lighted match was applied to the gas burner.

JUNE 28, 1925, PROVIDENCE, R. I. BAKERY. On Sunday morning, just after the gas burners had been lighted in a baking oven, an explosion occurred. The operator was blown through an open doorway, but was not injured. The oven was damaged so badly that it had to be rebuilt. Many of the windows were blown out of the surrounding walls.

The burners in this oven were lighted by an electrical ignition system which produced a spark at each burner every eight seconds day and night,



Travelers Standard.

When this portable domestic gas oven blew up, the housewife narrowly escaped injury. The gas flame, which had been turned low, was extinguished by a draft, and when this was discovered the burner was relighted without opening the door. A violent explosion followed.

whether the oven was in operation or not. The exact cause of the explosion is unknown, although it is evident that in some manner an explosive mixture of gas and air accumulated in the oven while it was being started.

A small fire which followed in the oven was extinguished by a chemical line used by the fire department. The loss, which was practically all caused by the explosion, was approximately $20,000. (S-40493.)

NOVEMBER 9, 1926, BROOKLYN, N. Y. PIE BAKERY. Preparatory to baking, the operator had lighted the six gas burners in the conveyor-type oven, and then turned down the three burners near the delivery end until their heat would be required. Air was mixed with gas at the burners. A diaphragm valve to shut off the gas if the air supply failed had been installed, but there was no device to stop the flow of gas if the gas pressure dropped. It is supposed that a drop in the city gas pressure caused one of the burners to go out, allowing gas to flood the oven. When the operator attempted to relight the burner with a gas torch, an explosion occurred which bulged out the sides of the oven and blew out windows on two walls of the building and skylights in the roof. The operator was seriously injured; other men were knocked down but not injured. No fire followed. The loss was estimated at $10,000. (S-43622.)

DECEMBER 22, 1929, MCKEES ROCKS, PA. BAKERY. A 50-foot conveyor type, gas-fired bread baking oven was damaged by a violent explosion which occurred at 10:30 A.M. The explosion was probably due to carelessness in lighting the oven, or a temporary interruption of the gas supply, permitting gas to accumulate in the combustion chamber. The damage from the explosion was estimated at $3000. (H-31632.)

Explosions in Mercantile and Institutional Occupancies.

Seventeen reports included in the N.F.P.A. file of gas explosions refer to mercantile and institutional occupancies. Seven of these were stores, four were banks and office buildings, and the remainder were occupied for miscellaneous purposes. Twenty-two persons lost their lives as a result of these explosions, and more than a hundred were injured.

It is interesting to note that in twelve of these explosions gas leaks were a contributing factor. In these twelve instances the ignition cause was as follows:

Lighted match used for illumination	2
Searching for leak with lighted match	2
Gas ignited from heating plant	1
Short circuit electric wires	1
Defective gas pilot on oil burner	1
Gas from gas plate ignited by lighted cigar	1
Unknown	4

Any record of gas explosions in mercantile establishments would be incomplete without mention of the explosion which occurred on December 21, 1921, in Columbus, Ohio, in a department store, where two were killed and

International.

Neighborhood grocery store in Wichita, Kansas, demolished when a plumber, called to repair a leaky gas pipe, struck a match and an explosion followed.

forty injured when gas, accumulating from a leaky main, seeped into the basement and exploded.

The explosion, according to press reports, occurred when gas, the presence of which was said to have been noticed the previous day, seeped through the basement walls and was ignited by the fire in the heating plant. Strength is given to this theory by the fact that the damage was confined largely to the front of the building and the sidewalk. Although the store was crowded with Christmas shoppers, those most seriously injured were pedestrians who were passing the store when the explosion occurred.

Typical Explosions in Mercantile Occupancies.

FEBRUARY 8, 1925, DOVER, N. H. BANK AND OFFICE BUILDING. A strong odor of gas in the basement was being investigated by the local fire chief accompanied by the janitor of the building. They searched the basement with the aid of a flashlight for about ten minutes without locating the leak. The chief then went to a corner of the basement where telephone cables entered and lit a match. Immediately there was a terrific explosion which blew out the front windows of the bank and shattered some of the cable pipes. A plug from one of the latter struck the chief and killed him. Six manhole covers in the street, the farthest nearly four hundred feet away, were hurled into the air by the force of the explosion. (H-21786.)

OCTOBER 8, 1925, ST. LOUIS, MO. OFFICE BUILDING. A gas explosion and ensuing fire in the Laclede Gas Light Company building caused the death of four persons, injuries to 57, and damage estimated at $71,000, of which $57,000 is attributed to the explosion and $14,000 to the ensuing fire. Occurring in a modern type office building of fire-resistive construction, the circumstances of this disaster are of particular interest. Gas escaped when an inadequately supported six-inch gas main in the basement, leading to two demonstration boilers, sagged and broke.

The cause of the ignition of the escaping gas was not determined. There was fire under the steam boilers, but they were located in a separate room some distance from where the explosion occurred. The gas-fired demonstration boilers were not being operated at the time. A spark may, however, have been produced by a number of causes, such as the broken pipe striking the floor, dropping of men's tools or other friction, lights, etc. There were also motors in operation in the basement, though not in the same room. The extent of the damage was due to the spread of the explosion through an inadequately protected pipe shaft. (For full details of this fire refer to QUARTERLY, Vol. 19, No. 3, p. 278.) (H-22560.)

JAUNARY 1, 1927, SAN FRANCISCO, CAL. BANK AND OFFICE BUILDING. When the janitor of the building pressed the button of the automatic elevator to bring it up from the basement to the first floor, a severe explosion occurred. This explosion shattered two elevator shafts, raised the reinforced concrete

P. & A. Photo.

First floor of the Laclede Gas Light Co. Building, St. Louis, after the gas explosion and fire. Four persons were killed and fifty-seven injured in this disaster.

roof of the building, caused the third floor to sag and damaged the second floor ceiling, ruined all of the office equipment on the third floor, such as filing cabinets, typewriters, desks, and smashed most of the plate glass in the neighborhood. The total damage amounted to $73,740.

The explosion was caused by the ignition of escaping gas in the elevator shaft, which came from an old gas plate formerly used in an employees' lunchroom on the third floor of the building. The gas for the entire building had been shut off when the use of this gas plate had been discontinued, but it had been turned on again twenty-four hours before the explosion so that a new sealing wax heating apparatus used by the bank might be operated. The old plate had not been capped when the gas had been turned off in the building; hence for twenty-four hours it poured out into the upper floors of the building and into the elevator shaft. No one had noticed it, since the explosion occurred on the afternoon of a bank holiday. (H-24102.)

FEBRUARY 5, 1927, TOLEDO, O. COMMUNITY HOUSE. Three persons were fatally injured when a gas explosion, followed by a fire, destroyed the building. Gas had seeped into the building from a rusted natural gas service pipe.

The gas was ignited by a match used to light a basement locker room by one of the victims, when a storm had disrupted the electrical service. (H-24226.)

NOVEMBER 26, 1927, CLEVELAND, O. RESTAURANT. An explosion occurred in the basement of the restaurant when gas from a leaky gas pipe was ignited as the manager struck a match to light a gas furnace. Loss $16,388. (H-25348.)

DECEMBER 29, 1927, PAUL'S VALLEY, OKLA. MERCANTILE. The owner of the building had the gas piping extended, doing part of the work himself. He had the gas turned on without having the work inspected. Gas from a leak in the piping filled the space under the floor and was ignited when the owner struck a match to light a gas stove in the kitchen, causing an explosion which wrecked the building. Several persons were injured. (H-25337.)

DECEMBER 5, 1929, MULHALL, PA. POST OFFICE. Six persons were killed and fifty injured by a gas explosion which wrecked this two-story building. The coroner attributed the blast to leaking gas after receiving information that persons in the building had smelled gas before the explosion, and after finding a rusted gas pipe in the basement with a quarter-inch hole therein due to corrosion. (H-28491.)

DECEMBER 5, 1930, BELOIT, WIS. BUSINESS DISTRICT. Four store buildings were completely destroyed, three others were badly damaged, and many windows and store fronts were broken by an explosion and fire said to have been due to gas escaping from a leaking main.

International.

When gas escaping from a broken main seeped into a basement and ignited from a heater in Beloit, Wis., early in the morning of Dec. 5, 1930, an explosion occurred which demolished four stores and damaged a number of others. Had this occurred during business hours the loss of life might have been heavy.

According to the local papers, a policeman detected the odor of gas escaping from a manhole at five o'clock in the morning and reported it. Gas company service men responded to his call and were about to close the valve located about a block away when an explosion occurred, blowing the roof off of one of the stores. A moment later a second explosion occurred, blowing débris through the top of the building. Fires starting in the basement of the stores involved four structures and their contents.

It is stated that a broken gas valve was discovered outside the store where the initial explosion occurred. It is believed that gas escaping from this valve penetrated through into the basement of the store and was ignited by the heating plant. The loss was estimated at from $200,000 to $250,000.

It is fortunate that the explosion occurred at a time when no one was in the street and the shattered buildings were empty of people. Had it occurred during a daylight hour when the buildings were occupied and pedestrians and motorists were in the streets the loss of life might have been heavy. (H-30452.)

Gas Explosions in Dwellings.

Gas explosions in dwellings are of relatively infrequent occurrence in view of the very widespread use of gas for house lighting, cooking and heating, and dwellings are naturally thought of as a non-hazardous class as regards explosions. Typical of gas explosions in dwellings are the following:

FEBRUARY 12, 1925, BARRE, VT. TENEMENT HOUSE. An explosion took two lives and caused injuries to five other persons when an occupant of the building carried a lighted lamp into the cellar where gas was escaping. (H-21791.)

Fireman's Fund Record.

Ruins of a home in El Monte, California, destroyed by a gas explosion. The occupants, warned by escaping gas from a high pressure main, fortunately had left the house when the explosion occurred. Despite the combustible character of the construction, there was no ensuing fire in this case.

Keystone.

The owner of this Canton, Ohio, home, wrecked by a gas explosion, was blown through the wall of the house and according to newspaper reports was found unconscious on the driveway, but escaped serious injury.

MARCH 5, 1925, EVERETT, MASS. DWELLING. Workmen left a gas pipe uncapped. When an occupant of the house struck a match an explosion occurred in which he was critically burned. Loss $1500. (H-21888.)

MAY 26, 1926, CANTON, OHIO. DWELLING. A street gas main was broken by a steam shovel. Following repairs to the street main by employees of the gas company, the gas was turned on, although a leak in a lead from the street main to a near-by house had not been repaired. Gas escaped and entered the house. An explosion occurred which completely wrecked the house. It is not known what ignited the gas. (H-23805.)

DECEMBER 27, 1926, VENTURA, CALIF. DWELLING. Gas from a leaking main followed a water pipe into a house and was ignited when an occupant of the house struck a match to light an oven. The house was wrecked by the explosion. (H-25996.)

JANUARY 2, 1927, GARFIELD, N. J. DWELLING. Twelve persons were injured in a gas explosion which demolished a two-story frame dwelling. The blast was caused by gas which seeped into the cellar from a leak in the street connection of a gas main. (H-24051.)

MAY 5, 1927, BROOKLYN, N. Y. TENEMENT. An explosion occurred during a tenement house fire, due to the ignition of gas which accumulated at the top of a shaft following the melting of a gas pipe by the fire. (H-24589.)

FEBRUARY 25, 1928, ELIZABETH, N. J. DWELLING. Eight thousand dollars damage was done by a fire which followed an explosion of gas leaking

D. A. Caldwell.

This picture shows the results of an explosion that wrecked a Moorhead, Minn., residence at 1:30 A.M., February 24, 1929. After the ensuing fire was extinguished, gas was found escaping in the basement. The house was vacant, but a fire was burning in the furnace in order to dry fresh varnish on the floors.

from a gas meter in the basement. One fireman was injured. (H-25653.)

FEBRUARY 23, 1928, SCARSDALE, N. Y. A pilot light on the laundry stove in the basement is said to have ignited gas from a leaky main, causing the explosion which severely damaged the building. (H-25665.)

JUNE 24, 1928, MANCHESTER, N. H. TENEMENT. One man was killed and five others injured in a gas explosion of unknown cause. The blast occurred as police forced their way into a room where they expected to locate a leak. A man occupying the room lost his life. (H-26200.)

NOVEMBER 7, 1928, PEABODY, MASS. DWELLING. An explosion occurred when a man looked for a gas leak with a lighted cigarette in his mouth. (H-26817.)

SEPTEMBER 26, 1928, QUINCY, MASS. DWELLING. A woman was seriously injured when her gas cooking stove exploded. The cause is unknown, but it is supposed that the gas was turned on too long before a light was applied. (H-26476.)

NOVEMBER 28, 1930, NORTH TONAWANDA, N. Y. DWELLING. The owner of this dwelling was attempting to repair a gas leak in his basement when the pipe pulled apart. He ordered his family from the house and summoned the fire department. The firemen entered the cellar and opened the windows to allow the gas to escape. They then returned to the outside of the building, where they were standing when an explosion occurred. The explo-

International.

Ruins of dwelling at Latonia, Ky., destroyed when gas from a leaky street main seeped into a basement and ignited when the furnace door was opened. One woman lost her life and two others were injured by the explosion.

sion, due to the ignition of gas from the furnace, wrecked the structure and took the life of one of the firemen, who was struck by flying débris. Six other firemen and four civilians were injured. (L-924.)

JANUARY 6, 1931, LATONIA, KY. DWELLING. One woman was killed and two others were injured as the result of a gas explosion that wrecked one house and badly damaged four others. The woman killed had gone to the cellar to put coal in the furnace. When she opened the furnace door there was an explosion that threw live coals over her, igniting her clothing. A simultaneous explosion occurred in the house adjoining, which also collapsed. A leak in the gas main in the street in front of the dwellings was blamed by the authorities for the explosion. (L-1040.)

Gas Explosions in Manholes, Sewers and Street Mains.

The fire record of manholes and sewers has already been published in the QUARTERLY (Vol. 23, No. 4, p. 402), but a record of gas explosions would not be complete without some mention of explosions that have occurred in manholes and sewers, or in street mains where damage has not extended to buildings. Moreover, as a result of data received subsequent to the publication of the fire record of manholes and sewers in the QUARTERLY for April, 1930, it is desired to correct the conclusions drawn as to the probable cause of two disasters there recorded.

The first of these corrections refers to the explosion and fire that occurred in a Post Office tunnel for telephone and telegraph wires in London, England,

Underwood & Underwood.

St. Paul residence wrecked by gas explosion and ensuing fire. Gas seeped into the building from a leaking gas main and was ignited by the pilot light of a gas stove.

on December 20, 1928. In the conclusions of this report the cause of the blast was attributed to the ignition of fermentation gases in the tunnel. The Commission of Inquiry appointed by the Home Secretary discarded this theory along with others, and reached the conclusion that the explosion was primarily due to a mixture of coal gas and air. The following paragraph from the report of the Commission summarizes their conclusions:

The explosion was due to a mixture of coal gas and air. We have not been able to trace the precise source of the gas but it was probably a gradual accumulation of leakage from neighbouring gas mains extending over a considerable period, increased by some larger untraced escape within a short time of the explosion. The gas was ignited in the manhole by some action on the part of one of three Post Office workmen, who were preparing to clear the air in a section of the tube with an air pump or blower. It was probably due to the use of a petrol lighter in the manhole by one of the workmen, P. G. Thrower, who unfortunately received fatal injuries.

The second correction refers to the sewer explosion which occurred in Ottawa, Canada, in May, 1929. Waste gasoline leaking into sewers has popularly been blamed for this explosion, in spite of the fact that gases lighter than air were found in considerable quantity by investigators after the explosion. The report of an expert made as a result of the disaster indicates that gas leaking into sewers from gas mains may have been a factor in the explosion.

Gas Main and Manhole Explosions.

APRIL, 1926, LOS ANGELES, CAL. GAS MAIN. A broken gas pipe line sent a blast of gas up through the pavement of a residential section. The gas

Fireman's Fund Record.

A gas leak was responsible for the explosion which wrecked this New Orleans dwelling.

was ignited by a passing automobile. Flames shot high into the air and threatened near-by dwellings, which were prevented from igniting by firemen who kept them cool by use of hose streams. The situation was made more dangerous by the presence of high tension wires on wooden poles. These poles ignited, but the flames were extinguished by the fire department. (H-32326.)

DECEMBER 19, 1927, EVERETT, MASS. GAS MAIN. When a street, apparently undermined, sank, a five-ton coal truck dropped into the hole. The weight of the truck broke a three-inch gas main and the escaping gas was ignited by the exhaust of the truck. The fire ignited the coal and the truck was damaged to the extent of $1000. (H-25364.)

APRIL 2, 1928, WHITE PLAINS, N. Y. GAS MAIN. One man was burned to death and three were severely injured when an automobile in which they were riding crashed into an eight-inch temporary gas main at the side of the road. The gas ignited and enveloped the car in flames. (H-25825.)

APRIL 3, 1930, NEW YORK, N. Y. GAS MAIN. A leaky gas main caused four manhole explosions on lower Broadway, cut this section off from telephone

communication, crippled traffic lights east of Broadway, and temporarily impaired the fire alarm system. The street was being repaired and it is thought that one of the mains had been cracked by the heavy trucks in use. The escaping gas may have been ignited by a spark from a workman's tool. (H-30528.)

DECEMBER 19, 1930, WASHINGTON, D. C. GAS MAIN. Two women were injured when a gas main broke under the sidewalk, filling the adjacent electric conduit with gas. A spark from the underground plow of a cable car is thought to have ignited the gas and caused the resultant explosion. (H-31629.)

JANUARY 28, 1931, OTTAWA, ONT. SEWER. About 4:50 P.M. an explosion occurred in a group of manholes and sewers. According to the official investigation of the explosion, the contributing cause was illuminating gas which had entered the soil, drain pipes and sewers due to defects and possible leaks in the distributing system. The explosion damaged the sewer system severely, as well as a number of dwellings located along the system. (H-31413.)

Fires in Which There Was Loss of Life.

Since the publication of the April QUARTERLY, the Department of Fire Record of the N.F.P.A. has received from various sources a total of 167 reports of fires in which loss of life has occurred. For the most part the fires recorded have occurred since April 1, 1931. While the number of fires reported to the N.F.P.A. is but a small fraction of the total number that have occurred during this period, the volume of data is sufficient to indicate the predominating causes of loss of life. These reports indicate a total of 299 lives sacrificed by fire during the period.

The fire causing the largest loss of life recorded in this tabulation was the fire which occurred in a sewerage tunnel under construction in Chicago, Ill., on April 13, 1931. Eleven men lost their lives in this fire and sixteen other persons were trapped for fourteen hours in an underground air chamber thirty-five feet below the surface. Four of the men who lost their lives were firemen and the others were laborers. All of the deaths are said to have been due to carbon-monoxide poisoning, which occurred after the fire had consumed the oxygen in the tunnel.

Other fires in which there was a large loss of life were those occurring on April 7, 1931, in a rural dwelling at Swan Creek, Ohio, when a father and seven children were burned to death; on April 28, 1931, at an oil well near

Loss of Life Fires, April-June, 1931.*

Class of Fire	No. Fires	Lives Lost			
		Men	Women	Children	Total
Airplane fires	13	21	2	1	24
Automobile fires	12	9	6	2	17
Apartments, hotels, lodgings, tenements, etc.	7	8	0	2	10
Dwellings—Urban	31	7	21	21	49
Dwellings—Rural	36	15	17	31	63
Industrial occupancies	7	20	0	0	20
Institutions, schools, etc	3	9	1	0	10
Mercantile occupancies	7	9	2	0	11
Mining property	3	12	0	0	12
Other buildings	14	11	1	9	21
Other than buildings	19	22	1	11	34
Oil refinery	1	3	0	0	3
Oil well or fields	3	14	0	0	14
Response to alarms	7	6	1	0	7
Ships	3	4	0	0	4
Total	167	170	52	77	299

*This table is made up from reports received by the Department of Fire Record between April 1 and June 30, 1931. A few of the fires included herein occurred prior to April 1, but were not reported until after that date.

Causes of Loss of Life, April-June, 1931.

Fatalities classified according to the immediate cause of the loss of life rather than according to the cause of the fire.

Cause	Men	Women	Children	Total
Airplane fires	21	2	1	24
Automobile fires	9	6	2	17
Children and matches	0	0	10	10
Cleaning with gasoline	1	4	0	5
Clothing ignited from bonfire	0	0	4	4
Clothing ignited from electric iron	0	0	1	1
Clothing ignited from oil lamp	0	1	1	2
Clothing ignited from open grate	0	1	1	2
Clothing ignited from stove	1	6	1	8
Clothing ignited from burning paper torch	0	1	0	1
Electrocuted by high tension wire	1	0	0	1
Escaping from fire—jumped or fell	3	0	0	3
Explosion—acetylene gas tank	1	0	0	1
Explosion—boiler	3	0	0	3
Explosion—carbide	0	0	1	1
Explosion—domestic lighting plant	1	0	0	1
Explosion—gasoline stove	2	1	0	3
Explosion—gasoline torch	1	0	0	1
Explosion—illicit still	2	0	0	2
Explosion—mine	12	0	0	12
Explosion—oil refinery	3	0	0	3
Explosion—oil stove	3	0	0	3
Explosion—powder mill	4	0	0	4
Explosion—rubber mfg. plant	1	0	0	1
Explosion—steel mill	10	0	0	10
Explosion—tar barrel	1	0	0	1
Explosion—yacht	1	0	0	1
Fell into fireplace	0	1	0	1
Fire fighting	14	1	0	15
Fuel oil piping ruptured	1	0	0	1
Gas ignited	8	1	2	11
Gasoline used to start fire	0	2	2	4
Ignition of flammable liquids or vapors	3	0	0	3
Kerosene used to start fire	2	5	4	11
Looking for gas leak with match	0	1	0	1
Oil well fire	9	0	0	9
Overcome by smoke or suffocation	12	2	0	14
Overexertion or excitement due to fire	3	0	0	3
Re-entering burning buildings	2	1	2	5
Responding to alarms	6	1	0	7
Smoking in bed	1	0	0	1
Trapped in burning building	22	10	39	70
Trapped by brush fire	5	0	1	6
No data	1	5	5	11
Total	170	52	77	299

Gladewater, Texas, where nine men were fatally burned; on May 11, 1931, in a mine explosion at River Hebert, N. S., involving a loss of six men; and on June 29, 1931, in a dwelling at Jonquieres, P. Q., which took the lives of eight children.

While for tabulation purposes only those loss of life fires occurring in the United States and Canada have been used, mention is here made of disasters occurring in other countries which are of interest because of the number of lives lost. The following information regarding these seven loss of life fires has been taken from press reports.

Over a thousand persons are reported to have been killed on March 31, 1931, when Managua, the capital city of Nicaragua, was devastated by an earthquake and fire. The exact number of deaths will probably never be known. There was little fire-fighting equipment in the city and almost no water, and the fire spread rapidly through the buildings damaged by the quake and took the lives of many of those trapped therein.

Forty-one passengers lost their lives when the Cairo-Alexandria express caught fire near Benha, Egypt, on the night of April 29, 1931. The fire developed from a hot box, and before the train could be stopped it spread through three of the passenger coaches. Many of the passengers leaped from the windows to their deaths in an effort to escape the flames, and others were consumed with the wooden coaches.

A terrific explosion occurred at the naval munitions laboratory near Rio de Janeiro, Brazil, on April 30, 1931, causing a loss of forty-six lives. Two buildings at the plant, in which approximately four hundred persons were working, were destroyed by the blast, which is believed to have started in a torpedo loading room.

Sixteen persons were burned to death and thirty were injured in a fire occurring during a motion picture performance held in a temporary structure in the village of Shimanaki, Japan, on May 12, 1931. The audience of two hundred were terrorized when the film ignited, and a wild stampede occurred. The fire overtook a number of the panic-stricken audience before they were able to escape.

Another of the unfortunate series of fires recently occurring in Japan was that which took the lives of fourteen persons when they were trapped in a blazing motion picture theatre in the town of Kanekemachi, on May 17, 1931. Almost eight hundred persons are said to have been in the building when the fire broke out, and many were crushed in a frantic rush for the exits.

Forty-seven miners lost their lives in a fire in a gold mine in India on May 26, 1931. Further details regarding this fire are lacking.

Ten persons lost their lives and a score more were injured in an explosion which occurred at the Royal Naval cordite factory at Holton Peats, England,

on June 23, 1931. The blast which destroyed the plant originated in a nitrating shed, where explosives were being mixed. All the persons killed were nitroglycerine workers.

Typical Loss of Life Fires.

Automobile Accident.

MT. KISCO, N. Y., MAY 14, 1931. A man was fatally burned when his car, which was being towed, got out of control and collided with the car ahead, causing the gasoline tank in the rear of that car to ignite. The victim's clothing was aflame when he escaped from the wreckage of his car and he received fatal burns before near-by residents were able to smother the flames.

Cleaning with Gasoline.

PHOENIXVILLE, PA., MAY 2, 1931. A young woman and her mother died of burns received when fumes from gasoline, which had been placed in an electric washing machine, exploded in their home.

Entering Burning Building.

STAMFORD, CONN., MAY 5, 1931. A woman lost her life in a fire which destroyed a sanitarium. She was not in the building when the fire started, but rushed to the third floor, where she believed her mother to be, and was trapped by the flames. The mother and seven other persons had escaped.

Explosion of Oil Drum.

CHARLESTON, W. VA., FEBRUARY 16, 1931. One man was fatally injured and several others received burns when fire broke out following the rupture of a steel drum containing kerosene under air pressure in one of the furnace rooms at a glass plant.

NEW YORK, N. Y., JUNE 8, 1931. Two boys lost their lives and two others were seriously burned by the explosion of an oil drum about which they were playing. The boys had built a bonfire against the drum, which they thought to be empty. With a tremendous roar the drum suddenly burst into fire and sprayed the burning oil upon the boys.

Fell While Atttempting to Escape Fire.

AGNEW, CALIF., FEBRUARY 26, 1931. Two men were making an experiment in a chemical plant when a flash of fire enveloped them. One of them in trying to protect his face fell from the platform on which he was standing and received fatal injuries. The fire on the men's clothing was promptly extinguished by automatic sprinklers.

Gas Explosion.

BROCKTON, MASS., MAY 26, 1931. A woman died of burns sustained as a result of looking for a gas leak in her cellar with a lighted match. An explosion occurred as she entered the cellar with the match in her hand, and she was enveloped in flames.

Jumping from Burning Building.

ROANOKE, VA., APRIL 3, 1931. One man was killed and another was seriously injured when they jumped from a third floor window to escape from an early morning fire which swept rapidly through the hotel. Several other occupants were burned or injured.

Mine Explosion.

RIVER HEBERT, N. S., MAY 11, 1931. Six men were killed and twelve injured in a mine explosion reported to have been due to an accumulation of coal gas. The blast occurred after a full day shift of sixty men had started to work, but fortunately those not killed outright were able to escape and bring the injured out with them.

Oil Refinery Fire.

WICHITA FALLS, TEXAS, APRIL 16, 1931. Three men were killed and two injured in an explosion and fire in an oil refinery. The three men who were killed were trapped in a room under a gasoline treating tower, which burst, scattering oil and blazing Fuller's earth over a large portion of the plant.

Oil Well Fire.

GLADEWATER, TEXAS, APRIL 28, 1931. Nine men lost their lives as a result of a fire which occurred as a wild oil well, which they were attempting to control, burst into flames. The blazing oil and gas flowing from the well ignited the oil soaked clothing of the workers.

Starting Fire with Kerosene.

PORTSMOUTH, OHIO, APRIL 24, 1931. Four members of a family of five, consisting of a father, mother and two small boys, lost their lives in a flash fire which occurred when kerosene was used to speed up the starting of a fire. Only a six-month-old infant survived.

Tar Barrel Explosion.

FRONT ROYAL, VA., JUNE 5, 1931. A young highway engineer died in a hospital of burns received when flames from an exploding barrel of tar being heated by street employees enveloped him.

Trapped in Burning Building.

JONQUIERE, P. Q., JUNE 29, 1931. Eight children, ranging in age from one to eleven years, were trapped in the upper part of a frame dwelling and burned to death. The fire is thought to have been due to an electric iron left on when the parents went to bed. The parents escaped, but in spite of their desperate efforts they were unable to save the children.

Woman Burned Fighting Fire.

KINGSTON, ONT., JUNE 4, 1931. A woman received fatal burns in a fire at her home. The blaze started when lace curtains at the windows were ignited by a match struck by her husband to light his pipe. The woman pulled down the blazing curtains and, as they fell, they ignited the mattress on the bed. In attempting to push the blazing mattress out of the window the woman's clothing ignited and she was fatally burned.